AD-A157 218 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 1/2
JEWELL BROOK DAM SITE (U) CORPS OF ENGINEERS WALTHAM
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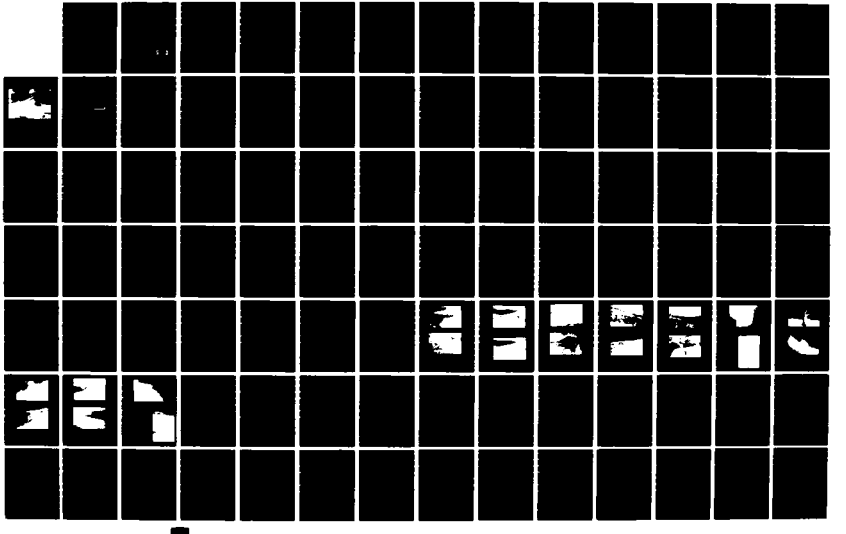

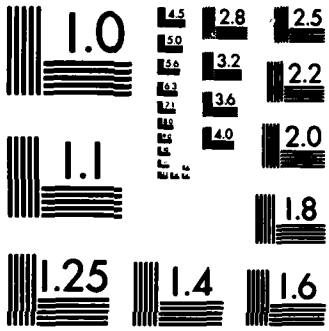

MICROCOPY RESOLUTION TEST CHART
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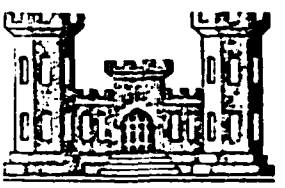
CONNECTICUT RIVER BASIN
LUDLOW, VT

JEWELL BROOK DAM SITE NO. 1
VT 00014

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
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WALTHAM, MASS. 02154

APRIL 1980

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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE *(and Subtitle)*: Jewell Brook Dam Site No. 1 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS	5. TYPE OF REPORT & PERIOD COVERED: INSPECTION REPORT
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18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

DAMS, INSPECTION, DAM SAFETY,

Connecticut Rwver Basin
Ludlow, VT.
Jewell Brook

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The dam is a zoned earth embankment that is 650 ft. long and 58 ft. high.. The project is judged to be in fair condition because it is doubtful that the grassed emergency spillway surface would withstand the velocities for the durarion of the test flood. The dam is intermediate in size with a high ahzard potential. The test flood for the dam is equal to the full PMF. There are various remedial measures which should be undertaken by the owner.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

AUG 26 1980

Honorable Richard A. Snelling
Governor of the State of Vermont
State Capitol
Montpelier, Vermont 05602

Dear Governor Snelling:

Inclosed is a copy of the Jewell Brook Dam Site No. 1 Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Water Resources, the cooperating agency for the State of Vermont. In addition, a copy of the report has also been furnished the owner, Town of Ludlow, Ludlow, Vermont 05149.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

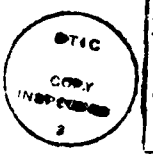
I wish to take this opportunity to thank you and the Department of Water Resources for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION REPORT
BRIEF ASSESSMENT



Identification Number:	VT00014
Name of Dam:	Jewell Brook Dam Site No. 1
Town:	Ludlow
County and State:	Windsor, Vermont
Stream:	Jewell Brook
Date of Inspection:	31 October 1979

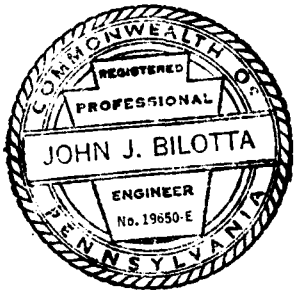
The Jewell Brook Site No. 1 Dam is a zoned-earth embankment that is 450 feet long and 58 feet high. It was constructed in 1969 to provide flood control for the Village of Ludlow, 2.4 miles downstream. The emergency spillway is a 250-foot wide cut in the left abutment, which is grassed and underlain by water-laid sands and silts. The crest is 5 feet below the dam crest.

The principal spillway crest consists of two, 7.5 foot long weirs 12.5 feet below the dam crest. The normal pool is controlled by an outlet with its invert 33.1 feet below dam crest. A reservoir drain, with its invert 47.2 feet below top of dam, is normally closed. These three outlets discharge into a 30-inch diameter concrete culvert that passes through the dam to an impact basin downstream.

Based upon the visual inspection and its past performance, the project is judged to be in fair condition because it is doubtful that the grassed emergency spillway surface could withstand the velocities for the duration of the test flood. Many aspects of the dam were in good condition. The inspection revealed heavy grass on all surfaces of the dam, minor seepage and erosion, and animal burrow holes on dam slopes.

In accordance with Corps of Engineers Guidelines for the Intermediate size and High hazard classification of the dam, the test flood will be equivalent to the Probable Maximum Flood (PMF). Peak inflow to the reservoir is 5300 cubic feet per second (cfs); peak outflow is 4020 cfs with 1.5 feet of freeboard. With a water surface at the crest of the dam, the capacity of the spillways is 7240 cfs, which is equivalent to 180% of the routed test flood outflow.

The owner should engage a registered qualified engineer to investigate the zone of seepage on the downstream side of the emergency spillway channel, and the suitability of the grass cover within one year after receipt by the owner of this Phase I Inspection Report. Recommendations should be made by the engineer and implemented by the owner. Other recommendations and remedial measures are described in Section 7 and should be addressed within one year after receipt of this Phase I Inspection Report by the owner.



Very truly yours,

DuBois & King, Inc.

John J. Bilotta, P.E.
Project Manager

This Phase I Inspection Report on Jewell Brook No. 1 has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably-possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that

a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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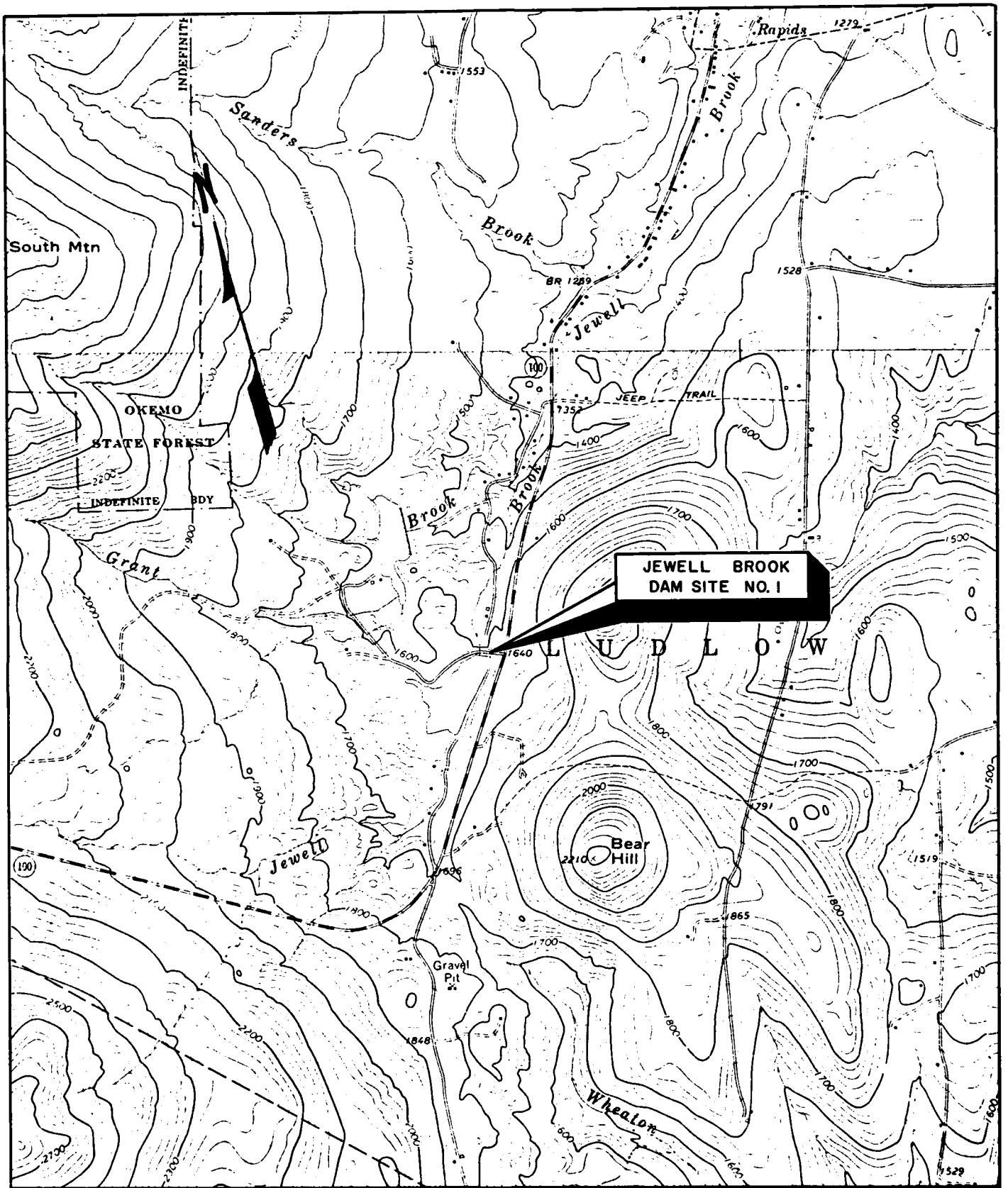
OVERVIEW PHOTOGRAPH
JEWELL BROOK DAM SITE NO. 1



DuBois & King inc.
engineering and environmental services
RANDOLPH VERMONT CONCORD NEW HAMPSHIRE

NATIONAL DAM INSPECTION PROGRAM

JEWELL BROOK DAM SITE NO. 1

LOCATION MAP

USGS QUAD. LUDLOW, ANDOVER VERMONT

DRAWN BY: JAS	DATE: 2/80
CHECKED BY: RMC	PROJ. NO.: 91111
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NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
JEWELL BROOK SITE NO. 1 DAM

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. DuBois & King, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Vermont. Authorization and notice to proceed were issued to DuBois & King, Inc., under a letter of October 19, 1979 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0003 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

(2) To encourage and prepare the states to quickly initiate effective dam safety programs for non-federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Jewell Brook Site No. 1 Dam is located in the Town of Ludlow, Windsor County, Vermont. The dam is located on Jewell Brook approximately 2400 feet upstream from its confluence with Grant Brook. The dam is shown on the 7.5 minute U.S.G.S. quadrangle for Andover, Vermont, with coordinates approximately 72° 43.4' west longitude, 43° 21.7' north latitude. The location of the Jewell Brook Site No. 1 Dam is shown on the Location Map immediately preceding this page.

b. Description of Dam and Appurtenances. Jewell Brook Site No. 1 Dam is a zoned, compacted earth embankment approximately 450 feet long and 58 feet high. The downstream two-thirds of the dam was constructed from the more pervious borrow, and the upstream third is the less pervious borrow. A thin layer, composed of rock from the downstream portion, was placed on the downstream slope. A five-foot deep cutoff trench was constructed under the less pervious material in the left half of the foundation and the left abutment. The downstream face is grassed and has a slope of 2.5 horizontal to 1 vertical. The upstream face has a slope of 2.77 horizontal to 1 vertical and is grassed. An underdrain system is located under the downstream portion of the dam.

Two spillways provide flow control, a principal spillway for normal flow, and an emergency spillway for overflow. The principal spillway consists of a two-stage reinforced intake structure, a 30-inch diameter conduit, and an impact stilling basin to dissipate energy at the outlet end of the conduit. A reservoir drain is connected at the bottom of the intake structure via a gated, 18-inch conduit. The emergency spillway is an ungated, 300-foot wide earth cut with a grassed surface.

c. Size Classification Jewell Brook Site No. 1 is 58 feet high and has a storage capacity of 584 acre-feet. In accordance with article 2.1.1 of the Recommended Guidelines for Safety Inspection of Dams, the dam is Intermediate in size based upon its height, which is greater than 40 feet and less than 100 feet.

d. Hazard Classification. The dam has a hazard classification of High based upon its potential for damage if breached. Development immediately downstream from Jewell Brook No. 1 Dam along Jewell Brook consists of scattered rural housing units and farm buildings. Approximately 2.4 miles downstream lies the Village of Ludlow. The flood wave generated by a break of this dam would be approximately 7.3 feet high when it reaches the confluence of Sanders and Jewell Brooks. The flood wave would have the potential of washing out 2 bridges on Vermont Highway 100 and causing appreciable damage to 15 to 20 dwellings along Jewell Brook, with flood levels up to 5 feet above the first floor of some of those dwellings. It is likely that more than a few lives may be lost if the dam is breached.

e. Ownership. This dam is owned by the Town of Ludlow, Vermont 05149.

f. Operator. The dam is operated and maintained by the Town of Ludlow, Vermont 05149. Mr. Dean Brown, Town Manager, is in charge of all Town equipment. His telephone number is 802/228-2841.

g Purpose. The purpose of this dam is to provide flood protection for the Jewell Brook flood plain area. It will retard runoff from a 100-year recurrence interval storm event without discharge occurring in the emergency spillway.

h. Design and Construction History. The Jewell Brook Site No. 1 Dam was constructed in 1969. The dam was designed by the Soil Conservation Service for the Town of Ludlow. The construction of the dam was funded under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666) as amended. The Town of Ludlow paid for the acquisition of the required land, easements, and rights-of-way.

The original design required fill in the downstream, right end of the emergency spillway to bring it to final grade. A persistent seep developed on the downstream face of the uncontrolled section, and in 1977 a quarry-run rock fill was placed over the seep area (See Section 6.1).

i. Normal Operating Procedure. The operation of Jewell Brook Site No. 1 Dam is automatic. During low flows, the water level is controlled by the hydraulic capacity of the low stage orifice (elev. 1585.1) of the principal spillway. As inflow increases, the hydraulic capacity of the low stage spillway is roughly constant causing the water surface to rise. The high stage inlet of the principal spillway and the emergency spillway become operational at elevations 1605.5 NGVD and 1613.3 NGVD, respectively.

1.3 Pertinent Data

a. Drainage Area The drainage area of Jewell Brook Site No. 1 Dam is 2.09 sq. miles. The terrain is mostly forested and is steep and mountainous. Topographic elevations in the watershed range from about 1560 to 3340. The drainage area is sparsely populated.

The tributary streams to the Jewell Brook Dam Site No. 1 are Jewell Brook and two unnamed intermittent tributaries. The tributaries are short, relatively straight, high gradient mountain streams.

The normal and maximum pool surface areas represent approximately 0.25% and 2.7%, respectively, of the drainage area.

b. Discharge at Dam Site.

(1) Outlet Works. A 30-inch diameter reinforced concrete conduit is located in the center of the dam. Based on as-built drawings, the conduit is 254 ft. long and has a slope of 0.06 ft. per ft. A reinforced concrete intake structure controls inflow into the conduit. The intake structure is approximately 36 ft. high. The low stage inlet consists of a rectangular orifice (1 x 1.5 ft.) and trash rack at elevation 1585.1 NGVD, 33.1 ft. below the top of the dam. The high stage inlet consists of two spillway weirs 7.5 ft. wide, each preceded by trash racks, with a crest elevation of 1605.5 which is approximately 12.7 ft. below the top of the dam. A reservoir drain with invert at elevation 1571 NGVD, consists of an 18 in. conduit controlled by a manually operated gate and is connected to the intake structure. A steel ladder provides access for the operator.

The maximum capacity of the 30-inch diameter conduit was calculated to be approximately 140 cfs with a water elevation at the crest of the dam (el. 1618.2).

(2) Maximum Known Flood. Based on a 1964 watershed study report entitled "Jewell Brook Watershed," the Jewell Brook Watershed has produced several damaging floods: 1927, 1930, 1938, 1952, and 1960. The report states that the 1938 flood was the most severe of them all. In the report it is estimated that a recurrence of the 1938 flood could cause damage of $870,000 (1964 figures). The majority of the damage occurred in the village of Ludlow. Industrial, commercial and residential property, and roads and bridges received extensive damage. There was also damage to agricultural, industrial and residential property, and roads and bridges along the Black River flood plain downstream from the confluence of Jewell Brook.

Since its construction in 1969, Jewell Brook Site No. 1 Dam has withstood two floods: 1973 and 1976. According to a town official, the 1976 flood was the more severe of the two. There are no written records of maximum pool elevations. It was estimated that the water surface rose to within 5 or 6 ft. of the elevation of the emergency spillway crest.

(3) Spillway Capacity at Test Flood Elevation. The test flood inflow for the 2.09 sq. miles is 5300 cfs. Surcharge storage of 504 acre ft. will attenuate the peak outflow to 4020 cfs (76% of test flood inflow) at elevation 1616.8 NGVD. The dam will have a freeboard of 1.5 feet during the test flood. The principal spillway will discharge approximately 140 cfs and the emergency spillway will discharge approximately 3880 cfs, for a total capacity of 4020 cfs. The discharge of the principal spillway and the emergency spillway represent 3.5% and 96.5% of the routed test flood outflow, repectively.

(4) Spillway Capacity at Top of Dam. When the water is at the crest of the dam, elevation 1618.2 NGVD, the principal spillway will discharge 140 cfs and the emergency spillway will discharge 7100 cfs for a total capacity of 7240 cfs, which is 1.8 times greater than the routed test flood outflow (4020 cfs).

(5) Total Project Discharge. The total project discharge at the top of the dam is 7240 cfs at elevation 1618.2 NGVD. During the test flood when inflow is 5300 cfs, the total discharge will be 4020 cfs at elevation 1616.8 NGVD.

c. Elevation (ft. above NGVD)

(1)	Stream bed at toe of dam	1560.5
(2)	Bottom of cutoff	1549 (lowest point)
(3)	Maximum tailwater	N/A
(4)	Conservation pool	1585.1
(5)	Full flood control pool	1605.5
(6)	Spillway crest (ungated)	1613.3
(7)	Design surcharge (original Design)	1616.0
(8)	Top of dam	1618.2 (lowest point)
(9)	Test flood design surcharge	1616.8

d. Reservoir (Length in feet)

(1)	Normal pool	1400±
(2)	Flood-control pool	1500±
(3)	Spillway crest pool	1500±
(4)	Top of dam	1800±
(5)	Test flood pool	1500±

e. Storage (acre-feet)

(1)	Normal pool	17.2
(2)	Flood-control pool	230
(3)	Spillway crest pool (ungated)	430
(4)	Top of dam	584
(5)	Test flood pool (full PMF)	521.2

f. Reservoir Surface (acres)

(1)	Normal pool	3.4
(2)	Flood-control pool	20
(3)	Spillway crest (ungated)	29.5
(4)	Test flood pool	34
(5)	Top of dam	36

g. Dam

(1)	Type	Zoned earthfill
(2)	Length	450 ft.±
(3)	Height	58 ft.±
(4)	Top Width	22 ft.
(5)	Side Slopes	
	Upstream	2.77H:1.0V
	Downstream	2.5H :1.0V

(6) Zoning - Based on design drawings, upstream third composed of the less pervious borrow, downstream two-thirds composed of the more pervious borrow. A thin layer of rock from the downstream zone was placed on the downstream slope.

(7) Impervious core - none (See Zoning)

(8) Cutoff - Trench cut about 5 ft. deep under left half of dam.

(9) Grout curtain - None.

(10) Other - None.

h. Diversion and Regulating Tunnel

Not applicable

i. Spillway

Low Stage Outlet		
	Type	Rectangular Orifice
	Size	1 x 1.5 feet
	Elevation	1585.1 NGVD
High Stage Outlet		
	Type	Two weirs
	Size	7.5 feet long each
	Elevation	1605.5
Emergency Spillway		
	Type	Grassed
	Size	250 foot wide channel
	Elevation	1613.3 NGVD

Flows entering the low stage outlet and the high stage outlet discharge into a common intake structure (the principal spillway) before exiting through a 30-inch diameter concrete pipe.

j. Regulating Outlets

The only gated outlet is an 18-inch diameter reservoir drain at elevation 1571.0 NGVD. This is operated only to drain the reservoir and is not a part of the usual procedure to regulate pool levels.

SECTION 2
ENGINEERING DATA

2.1 Design Data

There are two available sources of design information concerning the original construction of the dam. A watershed work plan entitled "Jewell Brook Watershed" published in 1964 provided background information concerning the design of the dam. The purpose of the report was to analyze the needs of the Jewell Brook Watershed and to make recommendations based on its findings. The report contains a summary of past flooding and a benefit-cost comparison to determine the most cost-effective solution for the flooding problem. Construction of four flood control dams in the Jewell Brook Watershed was recommended.

The other source, the Jewell Brook Site No. 1 design folder, provided specific design information. The design folder includes information on geology, soils, hydrology, and structural analysis. The folder contained detail calculations, contract drawings and specifications.

2.2 Construction Data

A set of as-built drawings of the original construction of the Jewell Brook Site No. 1 Dam is available at the Town Office. The drawings are detailed and are in good condition. The drawings consist of 26 photostatic reductions.

2.3 Operation Data

There is an operation and maintenance handbook for Jewell Brook Site No. 1 Dam in the Ludlow Town Office. There are procedures for monitoring the structure. The Vermont Department of Water Resources and the Soil Conservation Service perform a joint inspection of the dam annually.

2.4 Evaluation of Data

a. Availability. A copy of the watershed work plan entitled "Jewell Brook Watershed" is available from the Woodstock Soil Conservation District, Woodstock, Vermont, 05091. As-built plans and the original design folder are kept on file at the main office of the Vermont Soil Conservation Office. This information is available at the following address: Soil Conservation Service, One Burlington Square, Suite 205, Burlington, Vermont, 05401. Copies of annual field inspection reports are also available from that office.

b. Adequacy. The availability of in-depth engineering data permitted a review of the original design. Technical data pertaining to the original construction of the dam were readily available. As-built plans and design notes provided detail data for evaluating the structure.

c. Validity. The as-built drawings and the design data appear accurate.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Jewell Brook Site No. 1 Dam was performed on October 31, 1979. The weather was sunny and moderately warm with temperatures near 50°F (10°C). The inspection team included personnel from DuBois & King, Inc.; Geotechnical Engineers, Inc.; and Knight Consulting Engineers, Inc., accompanied by a representative of the USDA, Soil Conservation Service. A copy of the inspection report is included as Appendix A. At the time of the inspection the water was at conservation pool (el. 1585.1 NGVD) and flowing through the principal spillway.

b. Dam. This dam is a 58 ft. high earth embankment across Jewell Brook. The difference in elevation between the highest point on the top of the dam and the top of the principal spillway intake structure was measured to be 12.7 ft. This value differs slightly from as-built records which indicate a difference of 12.2 ft.

The upstream face has a slope of 2.77H:1V (Photo 1). The downstream face (Photo 2) has a slope of 2.5H:1V. The upstream and downstream slopes are well maintained. In zones where the grass was tallest, bare spots were frequently found. Also, small channels apparently pass under the root mat. Surface runoff tends to concentrate at the downstream abutment contact lines. Erosion channels up to 18 in. to 24 in. deep have formed at the downstream end of these contact lines. These channels will continue to erode unless protection is provided.

c. Appurtenant Structures. The intake structure with a 30-inch diameter concrete pipe outlet and an impact basin and a 250-foot wide earthen emergency spillway are appurtenant to the dam.

The approach channel to the emergency spillway has a reverse grade of 2% and is crossed by a gravel surface town road (Photo 3). Some trespassing was noticed at the base of the spillway and along the relatively flat area near the control section. Tire tracks in these areas may be attributed to haying operations.

Emergency Spillway. The emergency spillway (Photo 4) was cut into natural water-laid deposits (probably non-plastic) that make up the left abutment. About 150 feet downstream from the spillway crest, the slope of the discharge channel breaks from a 3% downgrade to a 3H:1V slope. Some of the materials cut to form the channel were used as fill in the vicinity of this breakpoint in the slope. The crest of the emergency spillway (Photo 5) varies in elevation by 0.4 feet over its width. The 3H:1V downstream face of the spillway (Photo 6) had not been mowed at the time of inspection. The downstream discharge channel is a hayfield below the toe of slope, which has been badly rutted by vehicles. These vehicle tracks continue a short way up the face of the spillway channel.

Approximately halfway down the slope there is a zone of riprap (Photo 8) that was placed in 1977 to control seepage issuing from the slope (Photos 7 and 9 are overlapping views taken from the right side). Elevation measurements taken on the day of inspection show that the elevation of the middle of the riprapped zone was about 8 ft. below the reservoir level. Based on the contract drawings, it appears that the water is exiting from the slope approximately at the level where the fill (placed for the discharge channel) intersects the original ground.

The quantity of seepage on the day of inspection was barely discernible. A zone at the toe of slope that was covered with tire tracks was overlain by a thin layer of silt due to previous higher flows. This silt was recent, since animal tracks were observed in it. The silt could be due to surface erosion, but it may also be due to the above-mentioned seep during periods when it flows with greater volume. It is not known whether the observed seepage is coming from the reservoir or from the natural ground in the left abutment.

Principal Spillway. The two-level intake structure (Photo 10) consists of a concrete tower with two openings. A 1.5 square foot orifice maintains a minimum pool level, and two 7.5-foot long weirs at elevation 1605.5 provide control for the primary spillway. These weirs are protected by a large hood and a combination grate and wide-bar trash rack which appeared to be in good condition (Photo 11). The concrete of the riser was in good condition with minor efflorescence at construction joints (Photo 12). The ladder was in good condition with minimal rusting. The orifice is protected by a cage-like trash rack (Photo 13) that was structurally sound and free of debris on the day of inspection.

Two of the stem guides for the pond drain service gate sheared off and the stem was bowed. This reportedly occurred by overtightening the stem.

The 30-inch reinforced concrete pipe exits into an impact-type energy dissipator. The declination between the end of the pipe and the vertical face of the backwall (Photo 14) appears to be caused by the slope of the pipe. Some breaking of the grout at the wall-to-pipe interface was noticed. The impact basin is in good condition (Photo 15) and was free-flowing and clear of debris on the day of the inspection.

An erosion zone that follows the right abutment contact line terminates at the right side of the impact basin. (Photo 16). The zones on both sides of the impact basin on the downstream side of the dam are protected with riprap. It appears that erosion has occurred in this vicinity in the past due to seepage, surface runoff, or eddies in the discharge channel during high water. These zones require annual inspection to detect potential erosion.

Some trees have been allowed to grow near the impact basin, which may have a deleterious effect on the riprap protection.

The drain pipes for the downstream foundation drainage system enter the impact basin through the side walls. The ends of these pipes originally were protected with animal guards, but the guard has been destroyed on one of them.

d. Reservoir Area. The area immediately upstream of the dam is grassed and clear of debris (Photo 17). There are scattered woodlots that may be inundated at maximum reservoir levels (Photo 18), but they did not appear to present any hazard or detriment to the operation of the reservoir.

e. Downstream Channel. The downstream channel is a natural stream with a cobble bed and vegetation along the banks (Photo 19). There are scattered stands of trees near the banks, but the valley has generally wide flood plains (Photo 20).

3.2 Evaluation

The dam appeared to be in good condition. Tall grass on the slopes, minor erosion and some small animal burrows were the only discrepancies noted. The erosion gullies at the abutment contact lines should be maintained.

The emergency spillway has been filled on its downstream side, and there was some seepage and a loss of fines noted. Tire tracks from haying operations may cause eventual erosion ruts; care should be taken to repair any deep tire tracks to prevent the initiation of erosion. The presence of grassed surfaces in the emergency spillway is discussed in Section 6.2.

The principal spillway riser tower is in good condition, and the impact basin at the outfall appears to be functioning properly. The cracking of the grout at the pipe-to-wall interface may be an indication of pipe movement, and deserves monitoring. Erosion to the right of the impact basin and along the right abutment contact line should be checked with proper maintenance procedures. The sheared stem guides pose no safety problem at present, but they should be repaired quickly.

The reservoir area and the downstream channel appear to be in good condition with little debris or forest litter.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. Jewell Brook Site No. 1 Dam serves as flood control for the Jewell Brook watershed. Its operation is automatic. The water elevation of the pool is regulated by the hydraulic capacity of the two-stage concrete riser of the principal spillway. A 3.4 acre permanent pool is maintained by the low stage orifice at elevation 1585.1. As the inflow exceeds the hydraulic capacity of the low stage orifice, the water surface rises. When the water surface reaches elevation 1605.5, water is discharged through the high stage inlet of the principal spillway. An emergency spillway is provided to serve as an emergency overflow during an unusually severe flood. The approximate drawdown time for the 100-year storm is 6 days.

The permanent pool can be drained or lowered manually by opening the reservoir drain. The drain consists of a drain inlet and an 18-inch diameter corrugated metal pipe connected to the principal spillway intake structure. Flow into the reservoir drain is controlled by a sluice gate located inside the intake structure. Its hand-operated mechanism is located on top of the intake structure. To operate the valve, the operator must climb the steel ladder attached to the intake structure. During low pool elevations, the operator can get to the intake structure by walking down the upstream face of the dam. During high pool elevations, the operator must use a boat to reach the intake structure.

b. Warning System. There is no system to warn of an impending flood or to warn of possible overtopping. The dam is inspected jointly by the Soil Conservation Service and the Department of Water Resources on an annual basis. Woodstock Soil Conservation District office personnel visually inspect the dam during heavy flows as a safety precaution. Town officials and maintenance personnel periodically make a visual inspection of the dam to check for unusual conditions.

4.2 Maintenance Procedures

a. General. There is no schedule for maintaining the dam. Maintenance is performed as needed. The town manager hires a local farmer to assure that the grass on the slopes of the dam is mowed at least once a year. In general, the dam has not required much maintenance since its construction. Local officials have stated that trespassing on the dam has become a problem. Vehicle tracks from 4-wheel drive vehicles and motorcycles are visible on the slopes of the dam. The tracks caused by the vehicles could lead to erosion problems.

4.3 Evaluation

In summary, no severe operational or maintenance deficiencies were found. The dam has required little maintenance since its construction.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General.

Jewell Brook Site No. 1 Dam was designed as a flood control structure. The appurtenant works are a principal and an emergency spillway. The principal spillway is a drop inlet structure consisting of a two-stage reinforced concrete riser, 30-inch diameter conduit of reinforced concrete water pipe, and an impact stilling basin to dissipate energy at the outlet end of the conduit. The drop inlet has low- and high-level inlets. The low level inlet is an orifice with dimensions 1'0"x1'6", invert elevation 1585.1 NVGD. The high level inlet is an overflow weir with a total weir length of 15 ft. and crest elevation of 1605.5 ft. NVGD. The riser has inside dimensions of 2.5 ft. by 7.5 ft. A concrete reservoir drain connecting to the base of the riser has an inside diameter of 18 in. and its entrance invert at 1571.0 NVGD. The emergency spillway is an earth cut in the left abutment with grassed surfaces. It has a base width of 250 feet and side slopes of 3H:1V with a crest at elevation of 1613.3 NGVD.

With water at the crest of the emergency spillway, the principal spillway will discharge 134 cfs. The emergency spillway can pass approximately 7100 cfs before the dam is overtopped. The normal water surface is maintained at 1585.1 NGVD, with the majority of the reservoir's storage allocated for flood surcharge storage. The normal pool storage of 17.2 acre feet occupies 3% of the maximum storage of 584.0 acre feet. The entire flood control process is automatic, no manual operation being needed to regulate the spillways.

The Jewell Brook Site No. 1 watershed is characterized by steep and rugged slopes. Its 2.09 sq. mi. drainage area is heavily forested, but the local soil conditions promote a substantial sediment runoff. However, a provision was made in the conservation pool volume for the 100 years of sediment accumulation.

5.2 Design Data.

Detailed hydrologic information pertaining to the original design of the dam was obtained from the Soil Conservation Service. This information was prepared in accordance with procedures as outlined in the National Engineering Handbook of the Soil Conservation Service, Section 4, Supplement A - Hydrology (NEH4A) and Section 5 -Hydraulics (NEH5). The information included a watershed analysis, flood routing, discharge frequency analysis and dam design criteria. The dam was tested with three probable storm conditions. The three storms represent a 100-year storm with three different antecedent moisture conditions. The dam was designed with a two-stage principal spillway. The low stage release rate was set as low as practical while staying within a six-day drawdown time. The high stage outlet was sized to use the full capacity of the 30-inch diameter conduit. Storage in the low stage was set to delay the operation of the second stage during the passage of a 6-hour, 100-year storm, so that its outflow would lag the peak from the uncontrolled area within the watershed for at least two hours. The information was reviewed and found to be in accordance with commonly accepted engineering practice.

5.3 Experience Data.

The Jewell Brook watershed has produced several damaging floods in past years. The major floods of record occurred in 1927, 1936, 1938, 1952 and 1960. Nearly every spring there was a potential flood danger from rapidly melting snow augmented by rainfall. The flood of September 1938 was the most damaging flood on Jewell Brook. The June 1960 flood, although not as large as the 1938 flood, did cause extensive damage on Jewell Brook and was the last flood of that magnitude prior to construction of the dam.

Jewell Brook Site No. 1 dam is one of four flood retarding structures that were constructed to control runoff, from the Jewell Brook watershed upstream of Ludlow. Together they control 75% of the Jewell Brook drainage area. Since construction (1968 through 1972), these structures have attenuated all floods without spilling water over their respective emergency spillways. However, the 1973 and 1976 floods reportedly exceeded the level of the upper stage of the principal spillway. The 1976 event reportedly rose to within 5 feet of the emergency spillway crest. The dams have helped alleviate flooding in the Village of Ludlow due to runoff from the Jewell Brook watershed.

5.4 Test Flood Analysis.

The 58-foot height of this structure places it in the Intermediate class, that range being greater than 40 feet and less than 100 feet. The hazard classification is High, based upon the close proximity of the Village of Ludlow and the location of many dwellings in the path of flooding from a potential dam break. In accordance with "Recommended Guidelines for Safety Inspection of Dams," the test flood is the full Probable Maximum Flood (PMF). The PMF curve envelope for Mountainous Areas was used to obtain a discharge per square mile value for the appropriate drainage area. This unit discharge was then multiplied by the drainage area of 2.09 square miles to obtain the PMF inflow of 5300 cfs. This test flood inflow was routed through the reservoir assuming the water surface to be initially at conservation pool (elevation 1585.1 NGVD). The structure can pass the full PMF without being overtopped. The resulting surcharge storage would attenuate the inflow to 4020 cfs outflow and result in a freeboard of 1.5 feet. Velocities at the control section of the emergency spillway would be about 7.9 fps. The 4020 cfs represents a reduction of 24% of the test flood inflow.

5.5 Dam Failure Analysis.

A hydraulic analysis for dam failure under test flood conditions was performed. Prior to failure, the water level would be at 1616.8 NGVD, and the structure would be spilling 4020 cfs. The breach height (water surface to upstream toe) would be 45.8 feet, and the breach would produce an instantaneous discharge of 39,200 cfs.

Since this dam impounds a relatively short reservoir, it was judged that a breach width of 15% of the dam width would represent a reasonable estimate for dam failure analysis. Thus, a breach width of 67.5 feet, and depth of water of 45.8 feet were used in the Saint-Venant equation to compute a breach outflow of 35,200 cfs over and above the 4020 cfs discharged by the structure during the test flood.

The breach would produce a wave 7.3 feet higher than the test flood level in Jewell Brook. The resultant stage would be 11.8 feet at the confluence of Jewell Brook and Sanders Brook, which is 1.2 miles downstream of the structure. This is expected to inundate approximately 20 houses producing water levels about five feet above the first floor levels in some instances. It is considered that this would endanger the lives of more than a few people. By the time it reached the populated area of the village, the flood wave would be 4.3 feet high and the stage would be 7.8 feet above stream bed. Here again, more than a few lives would be endangered, and therefore the dam is classified as High hazard.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations.

In Section 3.1 it was noted that a seep is exiting from the lower half of the emergency spillway discharge channel. The seep is presently barely discernible, but it has been sufficiently strong in the past to warrant placement of drainage materials on the zone of seepage. In 1977, a layer of bankrun gravel, followed by riprap (which was quarry run material from a rockblasting operation), was placed to control seepage and control erosion.

It is not known whether the above seepage is originating in the reservoir or in the adjacent natural ground. The gradient at the time of inspection from the reservoir to the exit point was about 0.016. During high reservoir levels, the average gradient would rise to about 0.07.

The materials beneath the spillway, through which this seepage may be occurring, are water-laid sands and silts, according to the design documents. Therefore, some layers may be erodible. For this reason it would be prudent to install piezometers on the upstream side of the seep. By monitoring such piezometers one could judge whether the seeps are emanating from the reservoir.

In addition, a trench should be dug in the zone which was covered with riprap to protect against erosion in order to obtain samples of the natural soil, the bank-run gravel, and the riprap. These samples should be tested to ensure that filter requirements are met. If not, replacement of the inverted filter is necessary. In addition, a flow monitoring system should be installed to enable direct collection and measurement of the seepage.

6.2 Design and Construction Data.

The emergency spillway is grassed and is composed of natural, water-laid deposits. The design velocity of flow in the spillway during a 100-year storm is 7.6 ft./sec. for a period of 5.2 hours. The design of the emergency spillway channel should be checked to determine whether the cover should be improved. The Soil Conservation Service has modified its guidelines pertaining to the design of earth spillways since the construction of this dam. Since the dam will impound large volumes of water during storms, rapid erosion of the spillway at those times could impose a greater danger downstream than would exist in the absence of the dam.

6.3 Post-Construction Changes.

The post-construction placement of an inverted filter on the downstream slope of the spillway discharge channel was discussed in Section 6.1.

6.4 Seismic Stability.

This dam is in Seismic Zone 2; hence, according to recommended guidelines, a seismic stability analysis is not warranted.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment.

a. Condition. On the basis of the visual inspection, the dam is judged to be in fair condition due to the possibly erosive soils in the emergency spillways. Minor seepage on the downstream side of the emergency spillway, erosion along the downstream abutment contact lines and to the right of the impact basins, the presence of a few small animal burrows, and tall grass on slopes could produce deterioration of the dam.

b. Adequacy of Information. This Phase I inspection report was based on visual inspection, on two previous inspection reports by Vermont State and Soil Conservation Service (SCS) personnel, on the design drawings and specifications and on the SCS Design Report.

c. Urgency. The recommendations presented in Section 7.2 and 7.3 should be carried out within one year upon receipt of this report by the owner.

7.2 Recommendations.

The following investigations and needed corrections should be performed under the direction of a registered engineer, qualified in the design and construction of dams.

(1) Determine whether or not the emergency spillway channel should be protected against erosion with materials more resistant than the existing grass cover.

(2) Evaluate the seep on the downstream side of the emergency spillway discharge channel, and determine whether or not the inverted filter placed over the exit point of the seepage is suitable or should be replaced.

(3) Design a simple device to collect seepage from the above location so that it can be monitored regularly.

7.3 Remedial Measures.

a. Operation and Maintenance Procedures. The owner should establish written procedures under the direction of a registered engineer qualified in the design and construction of dams. The following items should be included in these procedures.

(1) Mow grass and cut brush on all surfaces of dam and to a distance of at least 20 ft. downstream annually.

(2) Monitor seep and any instruments installed in the emergency spillway discharge channel at the frequency recommended by the engineer.

(3) After mowing, annually inspect slopes for animal holes and for erosion under root mat. Repair as needed.

(4) Place appropriate erosion protection at the lower end of the downstream abutment contact lines to prevent further erosion.

(5) Inspect sides of impact basin annually to determine whether erosion is occurring. Repair as needed with properly-filtered riprap.

(6) Inspect the control tower steel ladder and trash rack annually. Clean and paint as often as needed to control rusting.

(7) Establish written procedures for operating and maintaining the dam. The written procedures should include a formal downstream warning system and surveillance plan.

(8) Repair broken stem guides on control tower service gate for pond drain. Care should be taken to insure that the gate is operational.

(9) Operate drain valve annually to assure operability.

(10) Continue annual technical inspections.

7.4 Alternatives

None.

APPENDIX A

VISUAL CHECKLIST WITH COMMENTS

INSPECTION CHECKLIST

PARTY ORGANIZATION

PROJECT Jewell Brook Site No. 1

DATE October 31, 1979

TIME 1005

WEATHER Sunny, AM 46°F, PM 55°F

W.S. ELEV. _____ U.S. ___ DN.S.

PARTY:

1. John Bilotta D&K
2. John Somaini, D&K
3. Steve Poulos, GEI
4. Stephen Knight, Knight Cons. Engrs.
5. Paul Carlson, SCS
6. _____
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Earth Dam & Spillway	S. Poulos	
2.	Concrete Control Tower and Discharge Structure	S. Knight	
3.	Hydrology/Hydraulics	J. Bilotta	
4.			
5.			
6.			
7.			
8.			
9.			
10			

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 1

DATE October 31, 1979

PROJECT FEATURE

NAME J.J. Bilotta

DISCIPLINE

NAME S.C. Knight

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT AND RIGHT TRAINING DIKE OF EMERGENCY SPILLWAY	
Crest Elevation	1618.2 NGVD
Current Pool Elevation	1585.1 NGVD
Maximum Impoundment to Date	Not recorded, approximately El. 1608 in 1976
Surface Cracks	None observed
Pavement Condition	No pavement, crest is bare dirt road
Movement or Settlement of Crest	None observed
Lateral Movement	None observed. Dam arched d.s. on left abutment, where height over natural ground is low
Vertical Alignment	OK. Slight camber (superelevated) in the middle.
Horizontal Alignment	See Lateral Movement
Condition at Abutment and at Concrete Structures	Left abut. contact - good. Evidence of former erosion on left and right of outlet structure (impact basin). Right abut. contact - good, but has evidence of surface erosion that is slightly undermining the vegetation (grass). Condition good around intake structure.
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	Free access. Some car trails on d.s. slope but no erosion. Grass cover in good condition. Two chipmunk holes on upstream slope (Sta 0-25) 20 ft. to right of left abutment contact line and 10-15 ft. above water level.
Sloughing or Erosion of Slopes or Abutments	Intermittent erosion beneath root mat of grass, particularly the higher grass. Also in higher grass there are areas up to 3 sq. ft. that are unvegetated Minor

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 1

DATE October 31, 1979

PROJECT FEATURE

NAME J.J. Bilotta

DISCIPLINE

NAME S.C. Knight

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT AND RIGHT TRAINING DIKE OF EMERGENCY SPILLWAY - (CONTINUED)	
	sloughing of topsoil, possibly due to frost action. or wave cut during higher water levels. Slightly wave cut (6-10") at water line. Sloughing above may be wave cut due to spring water level. U.s and d.s. same except for wave cut. Also open spaces between grass less frequent downstream.
Rock Slope Protection-Riprap Failures	No riprap
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	Stone and filter material placed during construction on downstream toe of left abutment to control seepage that was observed exiting from natural ground. No seepage or wet areas evident during inspection.
Piping or Boils	None observed
Foundation Drainage Features	None
Toe Drains	
Instrumentation System	None
Vegetation	Downstream - Heavy matted tall grasses and weeds. Upstream - Same but bare spots where grass is tall.

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No 1

DATE October 31, 1979

PROJECT FEATURE

NAME J.J. Bilotta

DISCIPLINE

NAME S.C. Knight

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
DIKE EMBANKMENT - LEFT TRAINING DIKE OF EMERGENCY SPILLWAY, INCLUDING SMALL SADDLE DIKE AT UPSTREAM END.	
Crest Elevation	1618.2 NGVD
Current Pool Elevation	1585.1 NGVD
Maximum Impoundment to Date	Not recorded, approximately El. 1608 in 1976
Surface Cracks	Not observable. Heavy grass.
Pavement Condition	No pavement, crest is grassed.
Movement or Settlement of Crest	None observed
Lateral Movement	None observed. Left training slope of spillway arched slightly downstream
Vertical Alignment	OK
Horizontal Alignment	OK
Condition at Abutment	OK
Indications of Movement of Structural Items on Slopes	No structural items
Trespassing on Slopes	Free access. Good cover
Sloughing or erosion of Slopes or Abutments	None observed
Rock Slope Protection - Riprap Failures	No riprap
Unusual Movement or Cracking at or Near Toes	None observed
Unusual Embankment or Downstream Seepage	None
Piping or Boils	None
Foundation Drainage Features	None

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 1

DATE October 31, 1979

PROJECT FEATURE

NAME J.J. Bilotta

DISCIPLINE

NAME S.C. Knight

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
DIKE EMBANKMENT - LEFT TRAINING DIKE OF EMERGENCY SPILLWAY, INCLUDING SMALL SADDLE DIKE AT UPSTREAM END. (continued)	
Toe Drains	None
Instrumentation System	None
Vegetation	Excellent grass cover

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 1

DATE October 31, 1979

PROJECT FEATURE

NAME J.J. Bilotta

DISCIPLINE

NAME S.C. Knight

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	
Slope Conditions	Good. Grassed.
Bottom Conditions	Grassed.
Rock Slides or Falls	None
Log Boom	None
Debris	None
Condition of Concrete Linine	None
Drains or Weep Holes	N.A.
b. Intake Structure	See Control Tower Sheet
Condition of Concrete	
Stop Logs and Slots	

INSPECTION CHECKLIST

PROJECT Lowell Brook State No. 1

DATE October 31, 1979

NAME J.J. Bilotta

NAME S.C. Knight

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER AND SERVICE SPILLWAY	
a. Concrete and Structural	
General Condition	Good to excellent
Condition of Joints	Good
Spalling	None
Visible Reinforcing	None observed
Rusting or Staining of Concrete	Slight rusting below elevation of top slab. Curing compound stains present
Any Seepage or Efflorescence	Minor efflorescence at cold construction joint
Joint Alignment	Fair, a few areas were patched.
Unusual Seepage or Leaks in Gate Chamber	None observable
Cracks	No noticeable cracks except small cracks at joints
Rusting or Corrosion of Steel	Slight rusting of ladder Moderate rusting of trash rack at low stage.
b. Mechanical and Electrical	
Air Vents	n/a
Float Wells	n/a
Crane Hoist	none
Elevator	none
Hydraulic System	n/a
Services Gates (for pond drain)	At least two stem guides had failed and the stem was bowed for a 30'± section.
Emergency Gates	none
Lightning Protection System	none
Emergency Power System	n/a
Wiring and Lighting System	none

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 1

DATE October 31, 1979

PROJECT FEATURE

NAME J.J. Bilotta

DISCIPLINE

NAME S.C. Knight

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	Not observable
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 1

DATE October 31, 1979

PROJECT FEATURE

NAME J.J. Bilotta

DISCIPLINE

NAME S.C. Knight

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	(IMPACT BASIN)
General Condition of Concrete	Excellent
Rust or Staining	Minor staining - no rust
Spalling	No spalling
Erosion or Cavitation	None observed
Visible Reinforcing	None
Any Seepage or Efflorescence	Minor seepage and efflorescence at upstream corners
Condition at Joints	Conduit to concrete interface spalling of mortar at lower half of joint
Drain holes	None. 2-12" CMP (one each side) enter with invert at level of d.s. weir one. Animal guard missing.
Channel	Cobble bottom in good condition
Loose Rock or Trees Overhanging Channel	No rock. Small trees up to 10 ft. tall, to 150' d.s. A few tall maples and birch beyond that.
Condition of Discharge Channel	Good

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No 1 DATE October 31, 1979

PROJECT FEATURE NAME J J. Bilotta

DISCIPLINE NAME S.C. Knight

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SERVICE BRIDGE	No service bridge
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 1

DATE October 31, 1979

PROJECT FEATURE

NAME J.J. Bilotta

DISCIPLINE

NAME S.C. Knight

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
Approach Channel	
General Condition	Good. Grassed
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Grassed
Weir and Training Walls	
General Condition of Banks	Excellent. Grassed.
Rust or Staining	n/a
Spalling	n/a
Any Visible Reinforcing	n/a
Any Seepage	Spillway channel is in natural ground. About two years ago, sloughing occurred on downstream end where material had been placed. Sloughed material was removed, covered with clean bank-run gravel, which was covered with blasted rock over 30'x50' area. A trench was dug at the lower end to drain from beneath the blasted rock. Outflow was barely observable at time of inspection. Shallow deposit of silt on flat below sloping portion of spillway channel, indicating possibly some erosion at other times of the year and/or deposition from original slumps.
Drain Holes	n/a

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 1

DATE October 31, 1979

PROJECT FEATURE

NAME J.J. Bilotta

DISCIPLINE

NAME S.C. Knight

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (continued)	
Discharge Channel	
General Condition	Excellent
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Trees left and right but no significant overhang.
Floor of Channel	Grassed. Excellent
Other Obstructions	None

APPENDIX B

ENGINEERING DATA

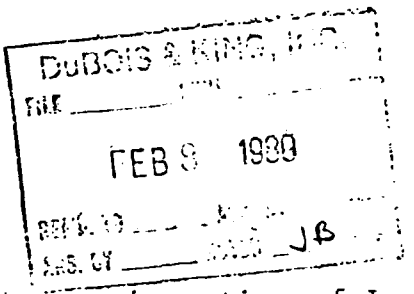
APPENDIX B

ENGINEERING DATA

Description	Location
1. Design Records - Jewell Brook Site No. 1 Dam	
A. Soil Conservation Service Design Folder	Soil Conservation Service 1 Burlington Square Suite 205 Burlington, Vermont 05401
B. Watershed work plan entitled "Jewell Brook Watershed", 1964.	Woodstock Soil Conservation District Woodstock, Vermont 05091
2. Past Inspection Reports	
A. List of Past Inspections	Appendix B, pg. B-2
B. Inspeciton Report Dated May 29 & 30, 1979	Appendix B, pgs. B-3 to B-10
C. "O&M Inspection Report" performed on 5/30/79	Appendix B, pgs. B-12 to B-12
D. Other inspection reports	Soil Conservation Service 1 Burlington Square Suite 205 Burlington, Vermont 05401
3. Plans	
A. Plan View - Jewell Brook Site No. 1	Figure B-1 pg. B-13
B. Section of Dam	Figure B-2, pg.B-14
C. Other As-Built Plans	Soil Conservation Service 1 Burlington Square Suite 205 Burlington, Vermont 05401

United States Department of Agriculture
Soil Conservation Service
One Burlington Square
Suite 205
Burlington, Vermont 05401

February 7, 1980



Mr. Don Morin
Dubois & King, Inc.
Randolph, VT 05060

Dear Don:

The dates of the annual operation and maintenance inspections of Jewell Brook Watershed are as follows:

1969 - May 20
1970 - May 26
1971 - June 2
1972 - August 9
1973
1974 - October 3
1975 - June 16
1976 - June 15
1977 - June 9
1978
1979 - May 30 and July 19

I couldn't locate the reports for 1973 and 1978. I know that the inspections were held. I inspected the sites immediately after the 1973 flood.

If I can be of any further assistance, give me a call.

Sincerely,

Paul Carlson

Paul Carlson
Civil Engineer

State of Vermont
Agency of Environmental Conservation
Department of Water Resources
Montpelier, VT 05602

DAM INSPECTION REPORT

Name JELLEL BROOK (SITE 1) DWR No. 117-7

Town LUDLOW NDS No. VT00 014

Owner TOWN OF LUDLOW Inspection Date 5-29-79

Address % TOWN MGR'S OFFICE, LUDLOW, VT. Last Inspected 1976 (SCS)

Telephone 228-2041 Hazard Class 1

Dean R. Brown, Jr. Town Mgr. Size Category

PERSONS PRESENT AT INSPECTION (Name and Organization):

Inspecting Party A. P. BARRANO, JR. - DEPT OF WATER RESOURCES

PAUL CARLSON - SCS, BURLINGTON

Others NONE

I. General Conditions at Time of Inspection

Weather PTLY CLDY - 60° HAD RAINED HEAVILY RECENTLY Ground Conditions WET

Water Surface Elevation -11.5' @ 1330 Datum TOP OF RISER

Accessibility BOTH SIDES ACCESSIBLE. RISER ACCESSIBLE BY BOAT

USED BOAT TO GET TO RISER.

Reservoir Area POND UP DUE TO HEAVY RAINS. CLEAR.

Remarks HWM MARK (DEBRIS LINE) -7.0' o/r/t TOP OF RISER

OPENED SLUICE GATE FOR 16" DRAIN @ 1330 5/29/79 WL = -11.5'

TO TRY TO LOWER WL ENOUGH TO INSPECT CONDUIT ON 5-30-79.

NOTE: NOT ABLE TO LOWER POND DUE TO OVERNIGHT RAIN STOPPING

FLOW RISER WAS OPEN - TOOK WILL CLOSE WHEN LEVEL

OKAY TO PERMIT "DRY" ACCESS.

II. Condition of Main Structure

Type of Construction EF

A. Upstream Face or Slope

1. Vegetative Cover HEAVY GRASS COVER (6"-24" HIGH). PATCHY IN PLACES. HAD BEEN PARTIALLY BURNED OFF LAST YEAR.

2. Erosion NONE

3. Slumps, Slides, Cracks NONE OBSERVED — SEE BELOW #4

4. Animal Burrows ① Several large burrows about ½ way up slope near right abutment ② many small burrows mid slope left of riser ③ several large burrows 8-15' below crest @ 4-oth R/o riser — some subsidence of slope apparently due to burrows

5. Slope Protection NONE

6. Debris MUCH DEBRIS FROM LOG UP TO HIGH FLOOD

7. Structural STABLE

8. Abutments OK

9. Alignment OK

10. Movement NONE APPARENT

11. Remarks GENERALLY GOOD CONDITION BUT DIFFICULT TO OBSERVE SLOPE BECAUSE OF HIGH GRASS. BURROWS SHOULD BE FILLED AND GRASS CUT.

B. Downstream Face or Slope and Toe

1. Vegetative Cover HEAVY GRASS COVER ON SLOPES. SOME BRUSH (2") ADJACENT TO OUTLET STRUCTURE & IN STONE FILL L/C OUTLET.
2. Erosion NONE
3. Slumps, Slides, Cracks NONE OBSERVED
4. Animal Burrows FEW SMALL BURROWS
5. Slope Protection NONE
6. Debris NONE
7. Seepage NONE OBSERVED, HOWEVER, GROUND WAS WET FROM PREVIOUS HEAVY RAIN.
8. Piping NONE OBSERVED
9. Boils NONE OBSERVED
10. Toe Drains NOT VISIBLE - OUTLETS BELOW WATER IN STILLING BASIN
11. Scour NONE
12. Structural SMALL
13. Abutments O/K - NO SIGNIFICANT EROSION ALONG DOWNSTREAM WAY AT LEFT ABUTMENT

14. Alignment OK.

15. Movement NONE APPARENT

16. Remarks GENERALLY GOOD CONDITION. BRUSH SHOULD BE REMOVED & GRASS CUT.

C. Crest

1. Vegetative Cover NONE EXCEPT AT EDGE

2. Erosion NONE

3. Evidence of Overtopping NONE

4. Settlement, Cracks NONE OBSERVED

5. Animal Burrows NONE OBSERVED

6. Debris NONE

7. Use of crest (road, trail, etc.) TOWN ROAD (GRAVEL)

8. Structural [illegible]

9. Abutments O/C

10. Alignment C/C

11. Remarks GOOD CONDITION

III. Condition of Outlet Works

A. Principal Spillway

Type CONC. RISER

Controlled or Uncontrolled UNCONTROLLED

1. Approach Channel NONE

2. Transition NONE

3. Control Section NONE

4. Discharge Channel CLOSE

5. Intake Structure CONC. IN GOOD CONDITION (OUTSIDE).

6. Conduit 30"ϕ RCP FLOWING FULL WITH DEBRIS OVER

7. Outlet Structure CONC. HEADWALL WITH CONC. BAFFLE ENTRY DISSIPATOR IN GOOD CONDITION

8. Trash Racks C/C

9. Anti-vortex Devices NONE

10. Stop Logs, Flash Boards NONE

11. Remarks IN GOOD CONDITION FOR (NOT INSIDE NORCE WATER)

B. Emergency Spillway

Type EC, UNLEITATED

Controlled or Uncontrolled UNCONTROLLED

1. Approach Channel CLEAR. GOOD GRASS COVER. TRAINING DIKE ON RIGHT AND LEFT SIDE SLOPE GOOD. LOCAL DRAINAGE.

2. Transition NONE

3. Control Section EXIST REPAIR - SEE BELOW

4. ~~Discharge~~ Exit Channel Town has repaired area that sloughed with gravel and stone fill (1800 cy per Tim). Stone fill for the most part is a poor quality schist and dirty. Gravel appears to be dirty (couldn't really locate any good gravel). Drawing & letter. Slope adjacent to fill have been mulched but not seeded. Slope is softened

5. Remarks not checked is not as free draining as it could be. Exit channel should be monitored to see how repair holds up.

C. Drawdown Facilities, Gates, Drains, Appurtenances, Etc.

1. Drawdown Facility 18"ϕ RCMP w/ RUBBER FRONT SLIDE GATE. GATE OPERABLE BUT SOME BINDING OF STEM DUE TO RUSTING SLIDE MECHANISM TOO HARD TURN WHEEL WHEN GATE CLOSED. FRONT INLET WHEN GATE OPENED (FULL).

[MANUAL OPERATE W/ WHEEL]

Condition OPERABLE. GATE NOT EXAMINED.

2. Other Gates, Drains, Appurtenances NONE

Condition

3. Remarks SCREW OPERATOR S/S GREASED. WHEEL FOR GATE OPERATOR KEPT IN TOWN MANAGER'S OFFICE.

IV. Operation and Maintenance

* GRASS IN E/S IS APPARENTLY MOWED BUT NOT ON SLOPES OF DAM. DEBRIS S/B REMOVED AND GRASS CUT.

V. Inspection Summary

A. Information Obtained

1. Photographs ✓

2. Dimensions

3. Other

B. Additional Information Needed

① CONDITION OF OUTLET CONDUIT — WILL INSPECT 5-30-79 IF WATER IS DOWN FAR ENOUGH ② D/S SLOPE SHOULD BE EXAMINED UNDER DRIER CONDITIONS

C. Overall Condition of Dam

GOOD BUT NEEDS MAINTENANCE — ① CUT GRASS ② FILL ANIMAL BURROWS ③ REMOVE DEBRIS *

* Per TM Dam Brown slopes are mowed every 3 years. OK but would be desirable more often for inspection purposes. 5/24/79 GWH

VI. General Comments

Dam in good overall condition. Some maintenance needed. Repair to E/S exit channel should be monitored.

Report By A. Peter Barrows, Jr. Date 5/30/79
A. Peter Barrows, Jr. PE
Dam Safety Engineer

Attachments:

Photos when developed.

5/30/79 1030 Meeting: Dean Brown, Alan Talerico (SCS), Paul Cahlson and APB to discuss preliminary findings of inspection.

① Site 1 in good overall condition but needs some maintenance - principally fill and stabilize areas on u/s slope caused by animal burrows and cut brush and small trees growing near outlet and burrows in slope fill near outlet. Don't over torque gate stem when closing.

② Per Dean Brown slopes are mowed once every 3 years to prevent brush growth. OK. Town picks up and disposes of debris annually.

③ Will reinspect d/s slope and inspect conduit when weather permits.

Copy to SCS 5/31/79
Cons

JEWELL BROOK WATERSHED
Sites No. 1,2,3, & 5

Site No. 1

O&M INSPECTION RECORD

Date of Inspection 5/30 and 7/19/79

STRUCTURE CHECK LIST

S*	U*		S	U
		1. Embankment		
X		a. Vegetation	X	
X		b. Erosion	X	
X		c. Leakage	X	
	X	d. Debris	X	
X		e. Wave Damage	X	
X		f. Vehicle Damage	X	
	X	g. Animal Damage	X	
X		h. Settlement or Cracking		
N/A		i. Riprap or Stone Facing		
X		j. Sloughing		X
X		k. Drain Outlets	X	
		2. Principal Spillway		
X		a. Riser		
X		(1) Concrete	X	
X		(2) Trash Racks	X	
X		(3) Ladder		
X		(4) Manhole		
	X	(5) Gate		
X		b. Conduit	X	
X		(1) Joint Separation		
X		(2) Condition of Pipe	X	
X		(3) Infiltration		
X		(4) Differential Settlement	Not observed	
		c. Impact Basin		
X		(1) Debris, Sediment		
X		(2) Concrete		
		d. Plunge Pool/Outlet Channel		
N/A		(1) Displaced Riprap		
		(2) Scour		
		(3) Evidence of Piping		

S	U	
		3. Emergency Spillway
X		a. Vegetation
X		b. Erosion
X		c. Debris/Sediment
X		d. Sloughing
X		e. Vehicle Damage
X		f. Sloughing
X		g. Slope Drainage
		4. Reservoir Area
	X	a. Debris/Sediment
X		b. Undesirable Vegetation
		5. Borrow Areas
X		a. Vegetation
X		b. Erosion
		6. Access Road
X		a. Erosion, Potholes
X		b. Ditches
X		7. Safety Hazards
		8. Monument

* S = Satisfactory U = Unsatisfactory

Remarks: (Explain unsatisfactory items above and any other items needing maintenance or repair).

See Next Sheet

U. S. Department of Agriculture
Soil Conservation Service
Vermont

OPERATION AND MAINTENANCE
WORKSHEET FOR INSPECTION RECORD

Project Jewell Brook W/S Inspection Date 5/30 and 7/19/79

Structure Site No. 1 Type Flood Control Dam

Type of Inspection: Annual [X]

Special [ ]

Sponsoring Local Organization Town of Ludlow

Present for Inspection Paul Carlson SCS

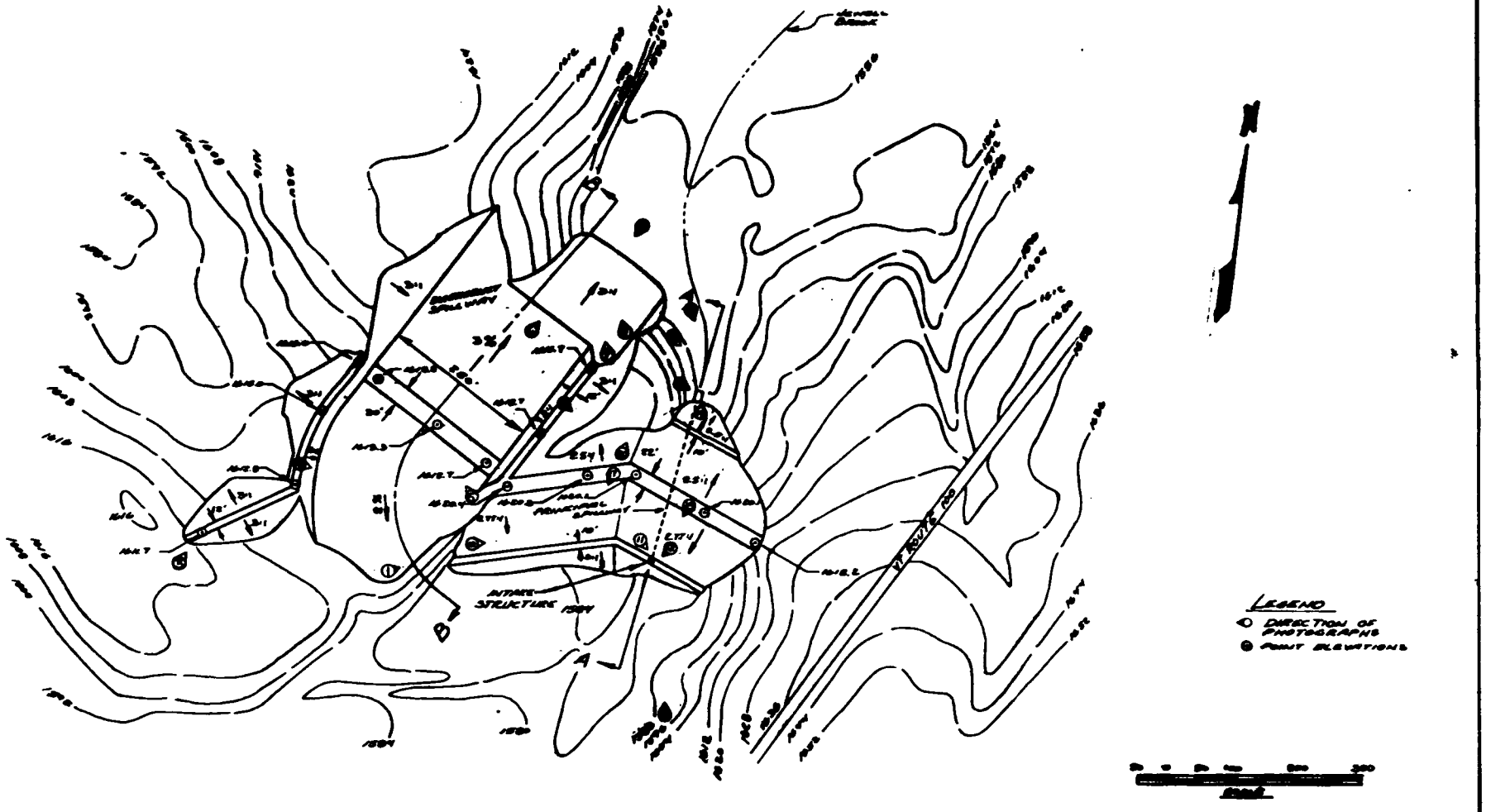
Item	Maintenance & Needed Repairs	Estimated Costs	Agreed Date Repairs to be Completed
1d. & 4a.	Remove debris	$30	
1a	Animal burrow on d.s. face near rt. abut. and at angle in dam	$40	
2.a.(5)	Gate stem bent and stem guides broken-repair or replace	$1000	

REMARKS:

SCS Representative

SLO Representative

Distribution: DC, SLO, State Office

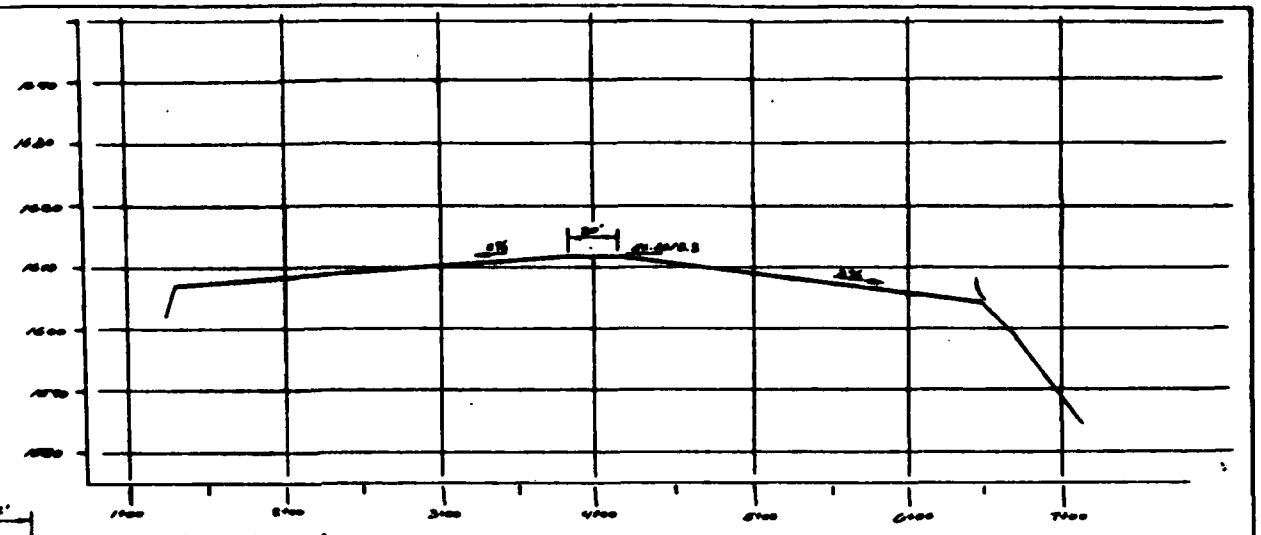


DuBois & King

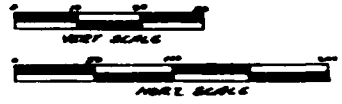
Department of the Army
New England Division
Corps of Engineers

National Dam Inspection Program
Jewell Brook Watershed
Dam Site No. 1
Ludlow, Vermont

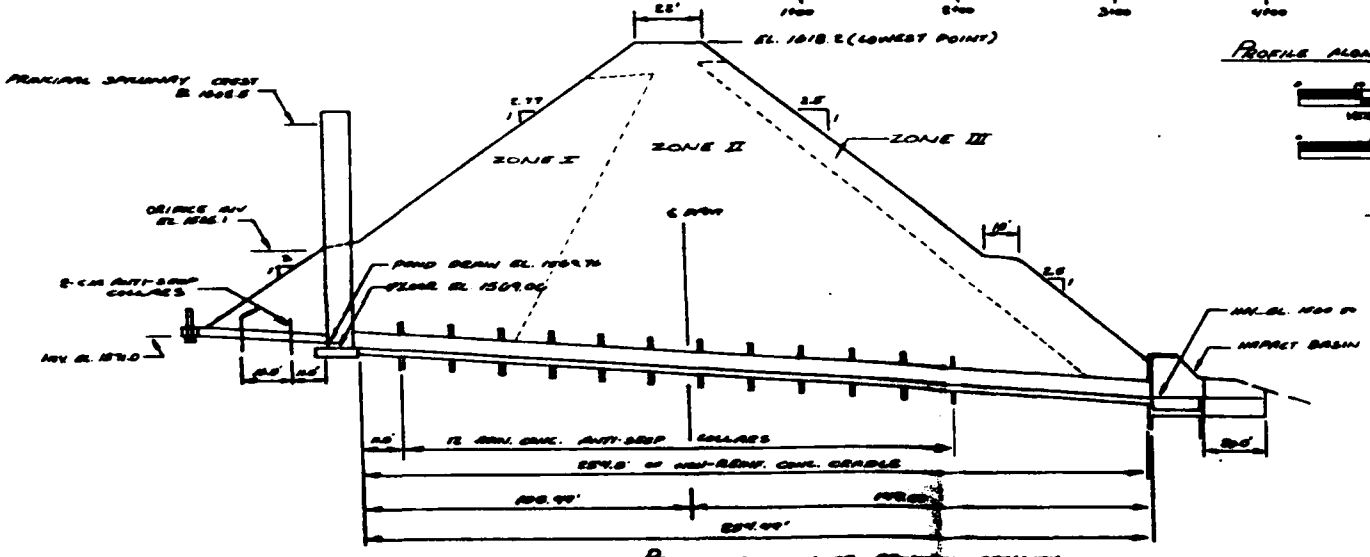
AAS	2/80
RMC	



PROFILE ALONG ℄ OF EMERGENCY SPILLWAY



SECTION B-B



PROFILE ALONG ℄ OF PRINCIPAL SPILLWAY

SECTION A-A

EARTH FILL	
ZONE	MATERIAL
I	SILTY SAND
II	SILTY SAND
III	ROCK RACED FROM ZONE II

DuBois & King, Inc.
engineering and environmental services

Department of the Army
New England Division
Corps of Engineers
Waltham, MA

National Dam Inspection Program
Jewell Brook Watershed
Dam Site No. 1
Ludlow, Vermont

JAS	2/80
TAC	91111

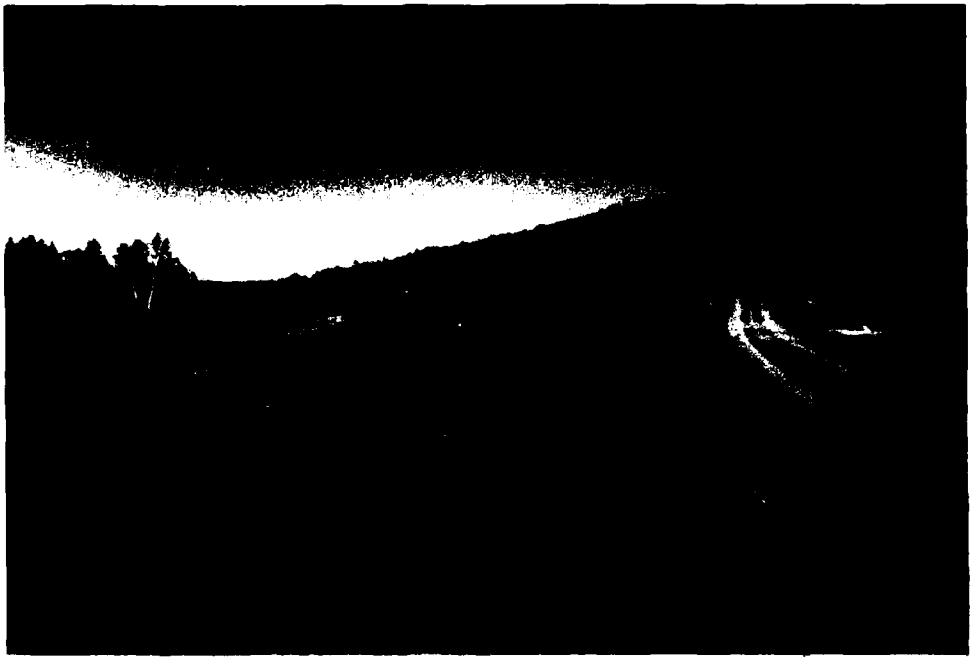
APPENDIX C

PHOTOGRAPHS

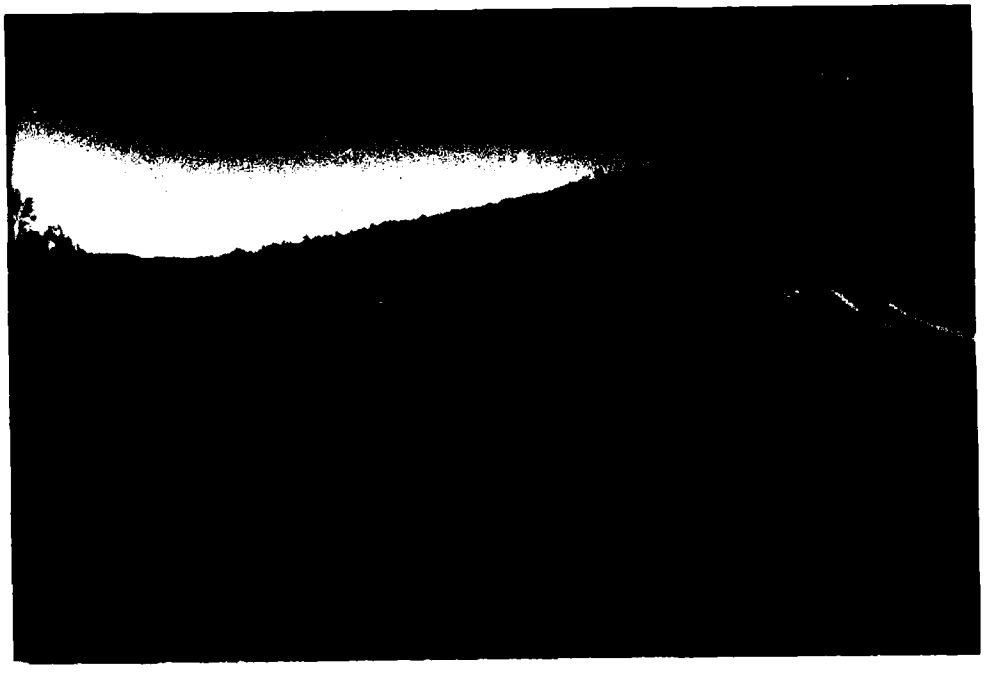
FOR LOCATION OF *PHOTOS*, SEE FIGURE B-1
LOCATED IN APPENDIX B

#1 UPSTREAM FACE OF DAM FROM LEFT ABUTMENT

#2 DOWNSTREAM FACE OF DAM FROM LEFT ABUTMENT



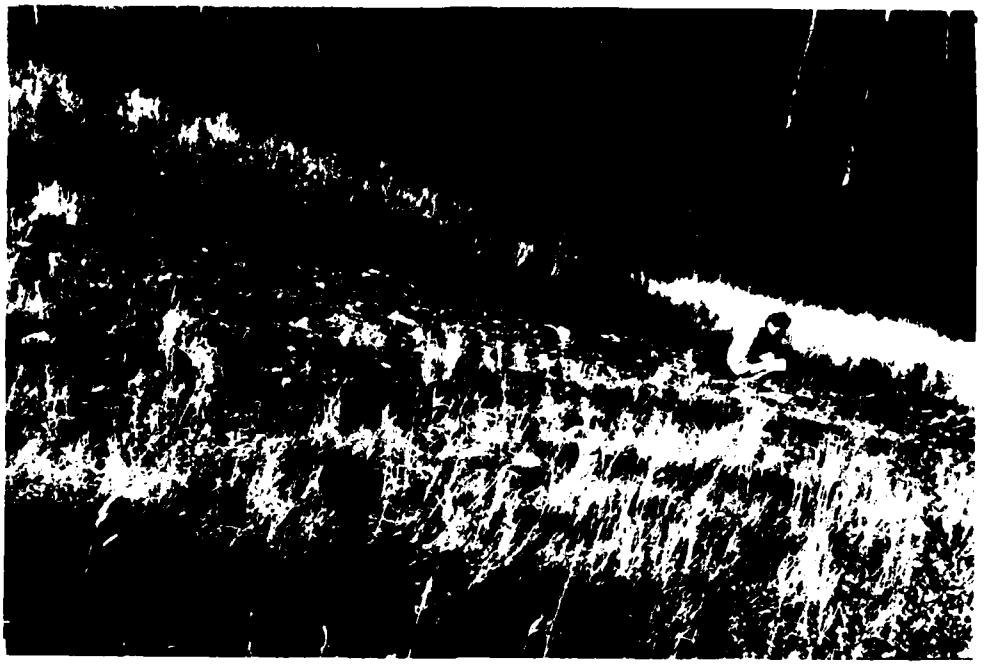
#3 TOWN HIGHWAY ACROSS EMERGENCY SPILLWAY AND CREST, LOOKING DOWNSTREAM



#4 EMERGENCY SPILLWAY, LOOKING FROM LEFT ABUTMENT, FLOW TRAVELS FROM RIGHT TO LEFT

#5 EMERGENCY SPILLWAY, LOOKING TOWARD LEFT ABUTMENT
FLOW TRAVELS FROM LEFT TO RIGHT

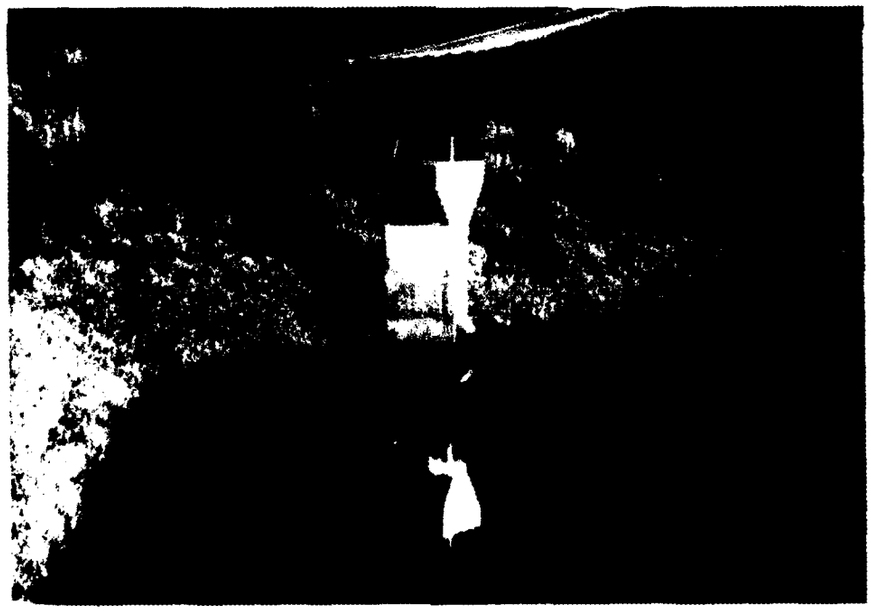
#6 ROCK FILL ON DOWNSTREAM FACE OF EMERGENCY
SPILLWAY LOOKING DOWNSTREAM



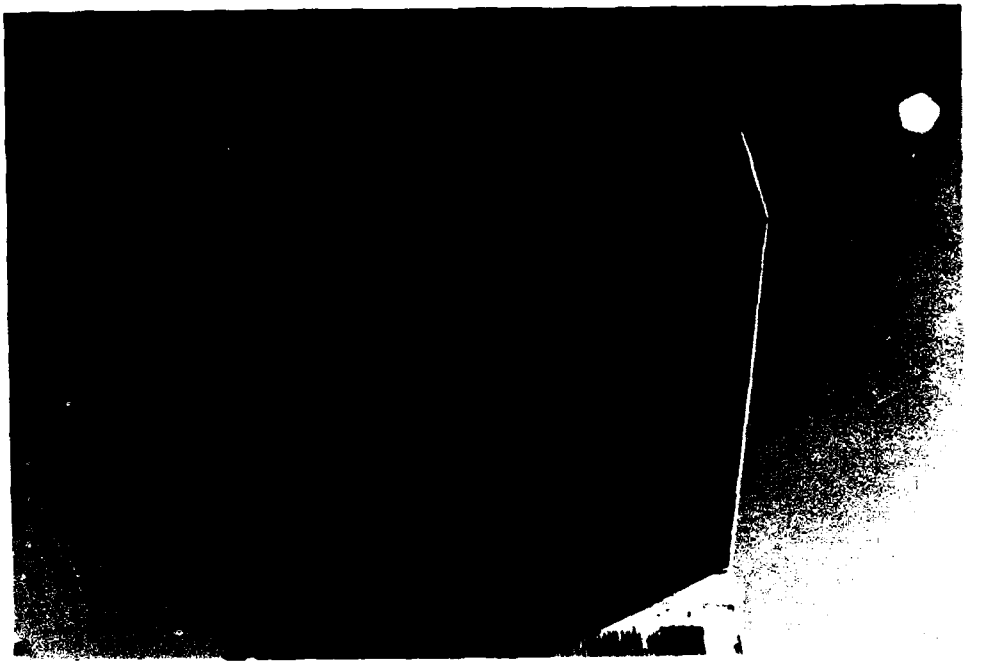
#7 ROCK FILL ON DOWNSTREAM FACE OF EMERGENCY SPILLWAY LOOKING TOWARDS THE LEFT

#8 LOOKING UPSTREAM AT ROCK FILL ON DOWNSTREAM FACE OF EMERGENCY SPILLWAY

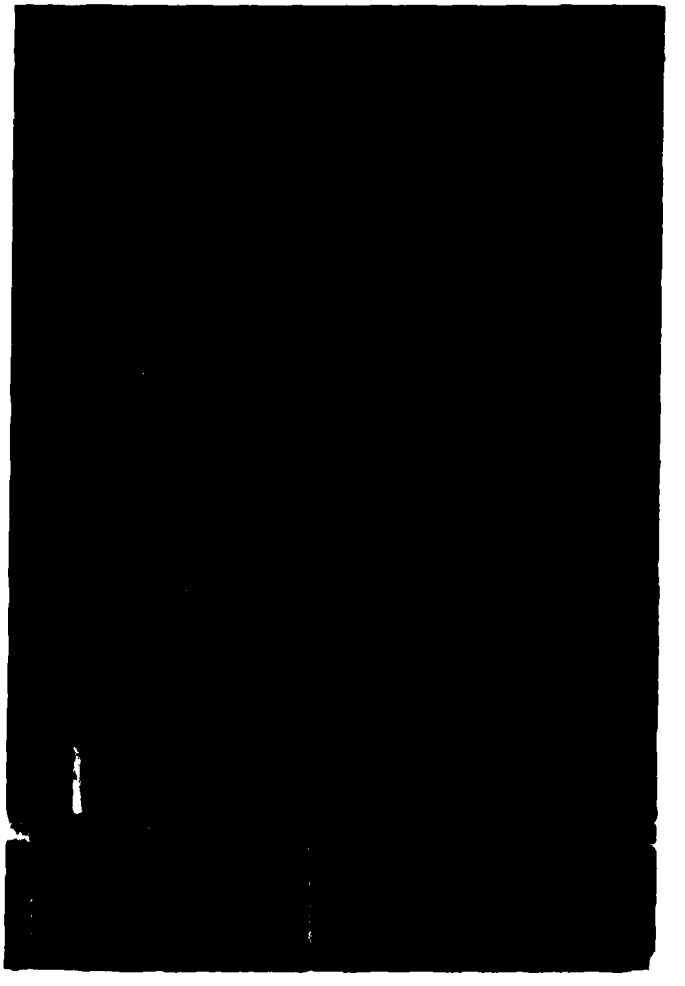
#9 TOE OF ROCK FILL ON DOWNSTREAM FACE OF EMERGENCY SPILLWAY, LOOKING TOWARD LEFT



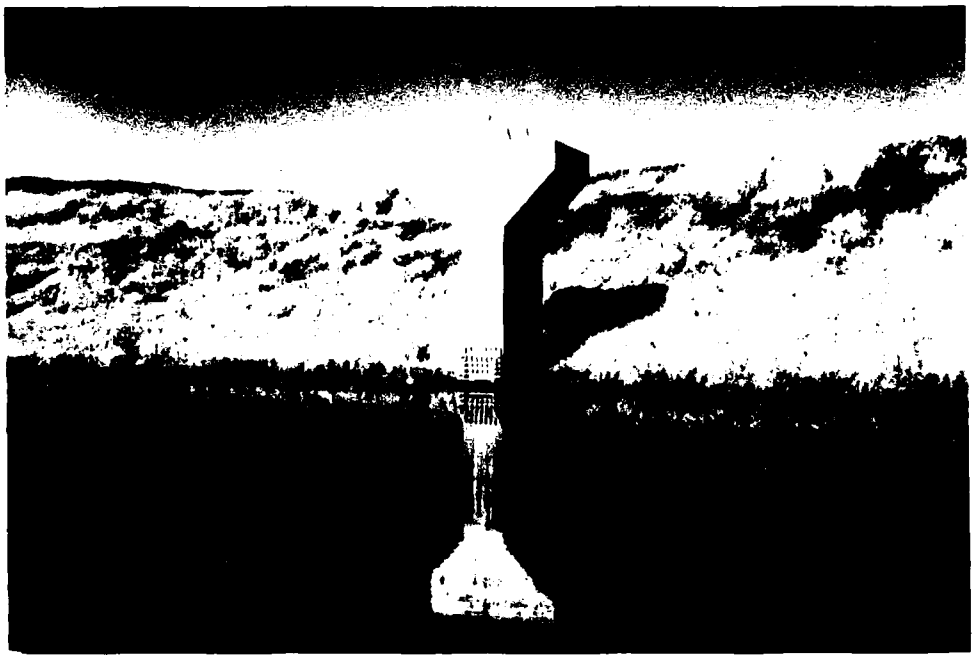
10 CONCRETE INTAKE STRUCTURE OF PRINCIPAL SPILLWAY



#11 BAR GRATE AND TRASH RACK FOR WEIR AT TOP OF INTAKE STRUCTURE OF PRINCIPAL SPILLWAY



#12 STEEL LADDER AND MOUNTING BOLTS



#13 TWO STAGE INTAKE STRUCTURE VIEWED FROM UPSTREAM

#14 DETAIL OF 30-INCH DIAMETER CONDUIT OUTFALL

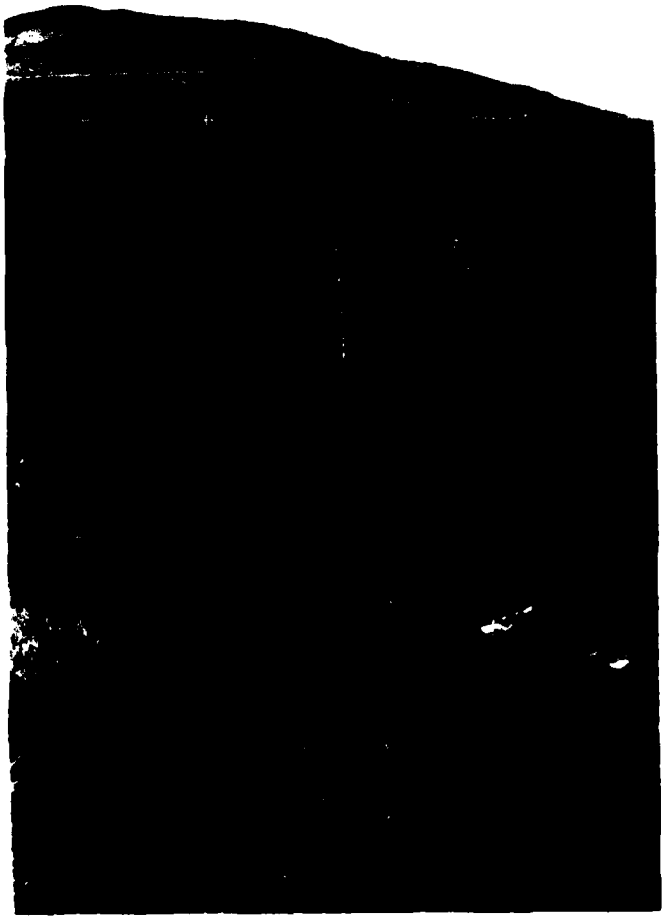
#15 IMPACT BASIN LOOKING UPSTREAM

#16 STONE FILL AT RIGHT ABUTMENT DOWNSTREAM CONTACT LINE

#17 LEFT SHORELINE OF RESERVOIR

#18 RIGHT SHORELINE AND RESERVOIR AREA

#19 CHANNEL DOWNSTREAM OF IMPACT BASIN



#20 VIEW OF VALLEY FLOOR
LOOKING DOWNSTREAM FROM
DAM CREST

APPENDIX D

HYDROGLOGIC AND HYDRAULIC CALUCULATIONS

DuBois & King, Inc. *ENGINEERING AND ENVIRONMENTAL SERVICES* RANDOLPH VERMONT 05060

Job No. 71111 Sheet 1 of 21
Project [illegible] Date [illegible]
Subject [illegible]
By [illegible] Ch'k. by

[illegible]

[illegible]

[illegible] Volume curve [illegible]

[illegible] checked [illegible] (see pages 2-4)

[illegible] checked [illegible] dam outlet [illegible] 7-11)

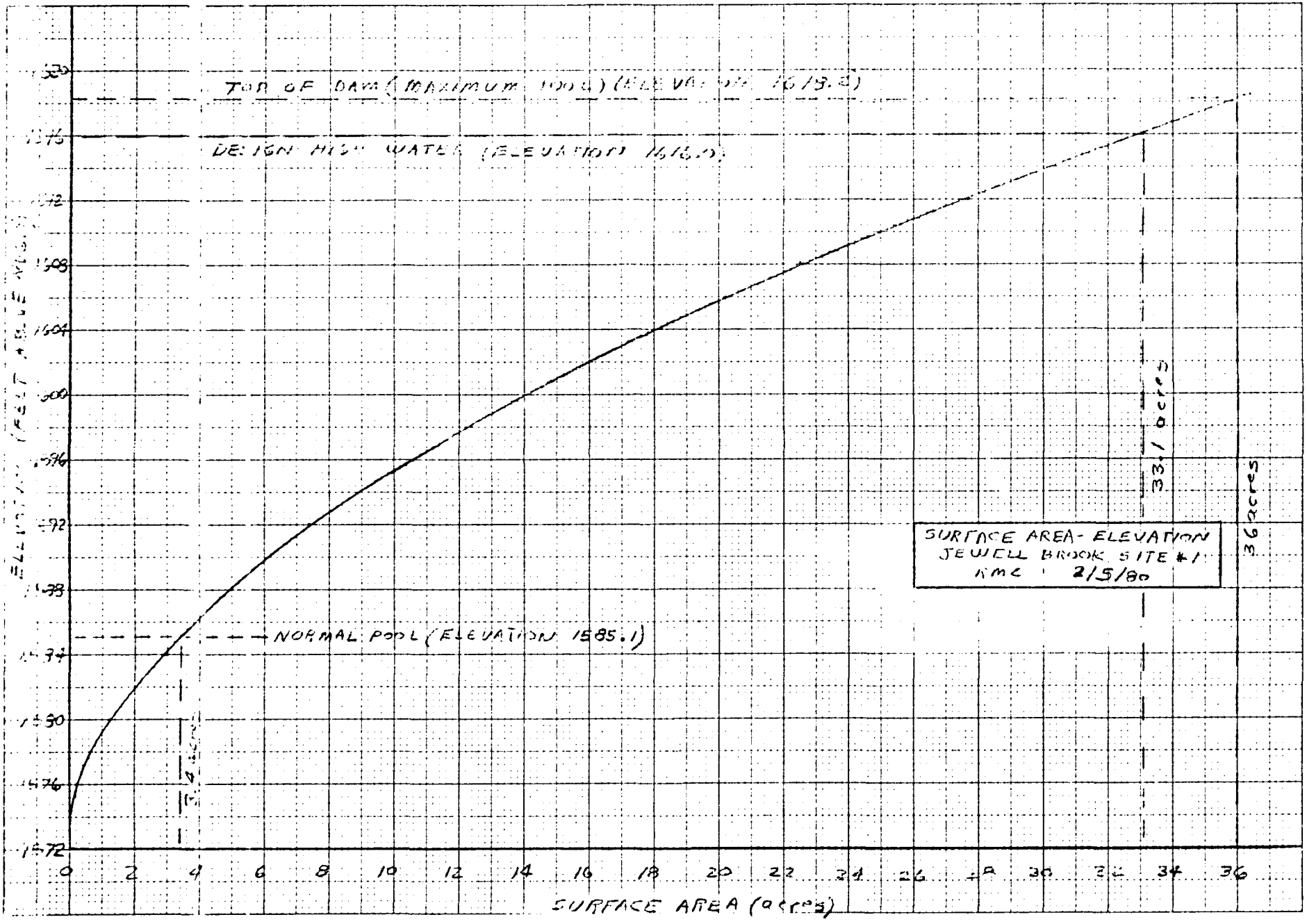
EP-1
Work Sheet for Tabular Computations

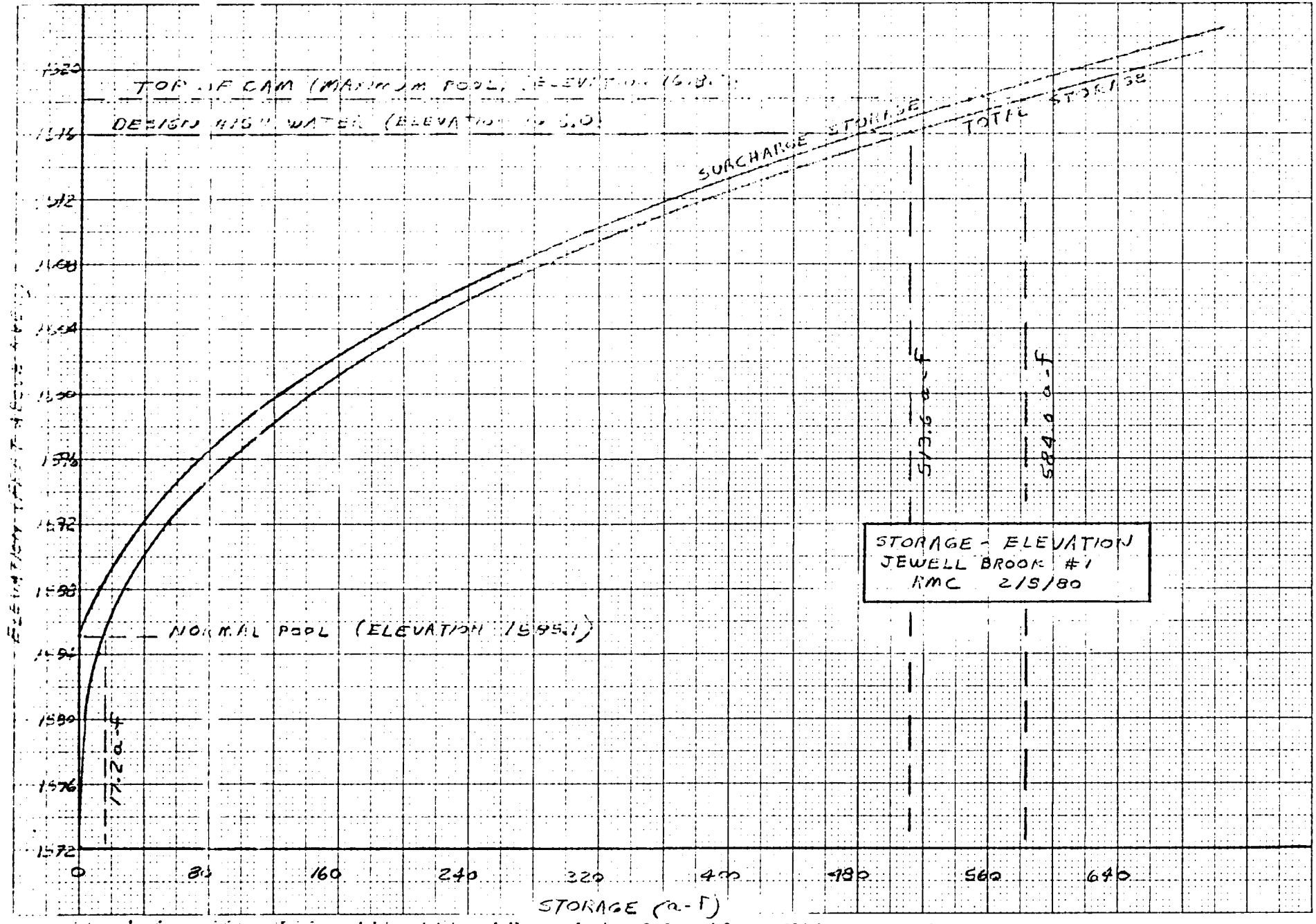
Jewell Brook Site #2

Storage Calculations By Don Ballou Dec 65

for Area - Capacity Curve 1918 1/12/66

Contour (ft)	Area (sq-in)	Area (Acres)	Vol (Ac-Ft)	TOTAL Σ Vol (Ac-Ft)		Area (Acres)	SURCHARGE VOLUME Avail Storage AF	
1572	0.64	0.09		0.1		109		
			0.62					
1576	1.46	0.22		0.62		.22		
1 = 80'			2.94					
1580	8.53	1.25		3.56		1.25		
1583.5			8.46					
1584	10.60 1.55	1.56 1.92		12.02		2.98		
1585.1			17.30	17.2			0	NORMAL POOL
Top Cone	12.25 4.22	1.80 3.87		29.32		5.67	13	
1588			26.12					
1592	13.90 5.82	2.04 5.35		55.44		7.39	40	
			37.14					
1596	15.50 9.68	2.28 8.90		92.58		11.18	65	
			51.50					
1600	17.36 13.10	2.55 12.02		144.08		14.57	123	
			65.66					
1604	18.80 INTERP	2.76 15.50		209.74		18.26	187	
1605.5			81.62	237.0			217.0	
1608	20.40 21.27	3.00 19.55		291.36		22.55	275	
			100.56					
1612	22.00 INTERP	2.25 24.50		391.92		27.73	379.-	
1613.3			12.10					
1616	23.60 32.30	3.47 29.65		513.62		33.12	491.-	




TOP OF DAM (MAXIMUM POOL ELEVATION 1596.0)
DESIGN HIGH WATER (ELEVATION 1595.0)
NORMAL POOL (ELEVATION 1595.1)
SURCHARGE STORAGE
TOTAL STORAGE
524.0 a-f
584.0 a-f
17.2 a-f
1592
1576
1580
1584
1588
1592
1596
1600
1604
1608
1612
1616
1620
0
80
160
240
320
400
480
560
640
STORAGE (a-f)
STORAGE - ELEVATION
JEWELL BROOK #1
RMC 2/5/80

Job No. 91111 Sheet 5 of 21
Project Jewell Brook #1 Date 1/2/80
Subject General By RMC Ch'k. by

Jewell Brook Site #1 - Located in Ludlow, VT

CLASSIFICATION: SIZE - INTERMEDIATE (based upon dam height)

HAZARD - HIGH (Based upon numerous downstream homes)

BASIC DATA:

DRAINAGE AREA = 2.09 mi^2 = 1338 acres

RESERVOIR: NORMAL POOL LEVEL - 1585.1'
area = 3.4 acres
storage = 17.2 a-f

DESIGN HIGH WATER LEVEL - 1616.0'
area = 33.1 acres
storage = 513.6 a-f

MAXIMUM POOL LEVEL - 1618.2'
area = 36 acres
STORAGE - 584.0 a-f

DAM: Earth w/ zoning, approx. 2½ : 1 side slopes
HEIGHT - US 47.2'
DS 58.2

LENGTH - approx 450 feet

OUTLET: Standard SCS Riser 2.5' x 7.5'
orifice - 12" x 18"
OUTLET PIPE - 2.5' diameter (30") RCP

EMERGENCY SPILLWAY: 250 foot wide earth w/ vegetation cover

Job No. 91111 Sheet 6 of 21
Project Jewell Block #1 Date 2/5/80
Subject Hydrology By RMC Ch'k. by

STEP 1 CHOOSE TEST FLOOD

SIZE - INTERMEDIATE

HAZARD - HIGH

USAM SAFTEY GUIDE LINES RECOMMENDS

FULL PMF

ENTER PMF CURVE ENVELOPE

BASIN MOUNTAINOUS, DA = 2.09 mi^2

PMF = 2525 cfs/mi^2

PMF = $\frac{2525 \text{ cfs}}{mi^2} \times 2.09 mi^2$ = 5277.25 cfs Ag 5300 cfs

PMF = 5300 cfs

STEP 2 RATING CURVE

SCS RATING CURVE DATA CHECKED AND
RL PLOTTED

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

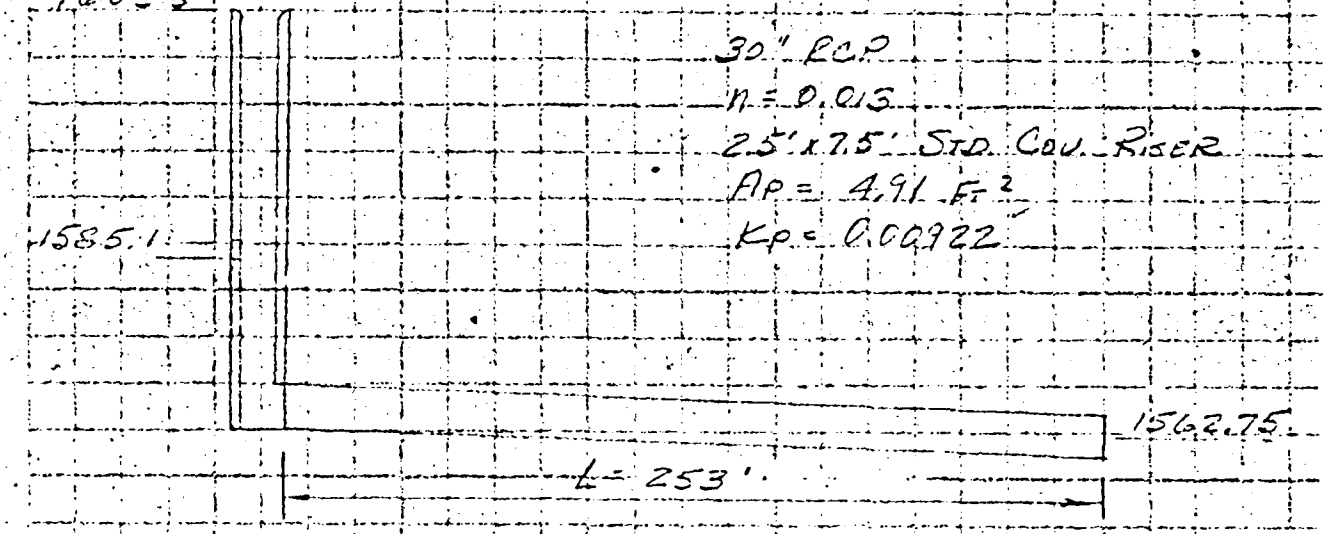
GPO 1958 O—470688

STATE	PROJECT		
VERMONT	JEWELL BROOK WS		
BY HHB	DATE 1/5/66	CHECKED BY DON BALLOU	DATE JAN 66

JOB NO. SITE No. 1

SUBJECT DISCHARGE CONSTANTS

SHEET [redacted] 7 of 21



30" RCP
n = 0.013
2.5' x 7.5' STD. COV. RISER
Ap = 4.91 Ft²
Kp = 0.00922

ORIFICE

Q = 35 CFS @ El. 1605.5 H = 20.0'

$Q = CA\sqrt{2gh}$

$AREQ. = \frac{35}{0.67\sqrt{64.4 \times 20.0}} = 1.46$ ☐'

USE 18" WIDE x 12" HIGH ORIFICE

$Q = 0.67(1.5)\sqrt{64.4}\ h^{1/2}$

$Q = 8.05\ h^{1/2}$ ✓ OK

PIPE

$Q_p = C A_p H^{1/2}$

$C = \sqrt{\frac{2g}{1 + K_e + K_p L_p}} = \sqrt{\frac{64.4}{1 + 1 + 253(0.0092)}}$

$C = 3.85$

$Q_p = 3.85\ (4.91)\ H^{1/2} = 18.9\ H^{1/2}$ ✓ OK

WEIR

$Q_w = 3.1(6D)H^{3/2} = 46.5\ H^{3/2}$ ✓ OK

$H_{max} = 2.50 - 1.25 = 1.25$' DIKE PERIMETER @ 1.25'

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
VT		JEWELL BROOK WATERSHED		
BY	DATE	CHECKED BY	DATE	JOB NO.
T.B	1/14/66	Don Ballou	Feb 66	

SUBJECT: EMERGENCY SPILLWAY DISCHARGE — SHEET [redacted] 8 of 12

$L = 200'$ $b = 250'$ $Z = 3$ $n = 0.04$

ES 124 3/7

q	Hp	dc	Z dc	W	Q EM	EL
5	1.76	0.92	2.76	252.76	1262	1615.06
10	2.65	1.47	4.41	254.41	2544	1615.95
15	3.39	1.92	5.76	255.76	3830	1616.69
20	4.04	2.35	7.05	257.05	5140	1617.34
30	5.14	3.05	9.15	259.15	7770	1618.44

SCS 347 6-57
Tabular Computations

U S DEPARTMENT O
SOIL CONSERVATI

Jewell Brook WS Site No. 1

Stage-Discharge Computations

	Elev.	Orifice		Weir		Weir + Orifice	Conduit	
		h_o	$Q_o = 8.05 h_o^{1/2}$	h_w	$Q_w = 46.5 h_w^{3/2}$	$Q_o + Q_w$	h_p	$Q_p = 18.9 h_p^{1/2}$
SED POOL	1585.1	0	0					
	1587.6	2.0	11.4					
	1589.6	4.0	16.1					
	1594.6	7.0	24.2					
	1601.6	16.0	32.2					
RISER CREST	1605.5	19.9	35.9					
	1606.75	21.15	37.0	1.25	65.1	102.1	44.0	125
	1608.0	22.4	38.1	2.5	184.0	222.1	45.25	127
	1610.0						47.25	130
& SPILLWAY	1613.3						50.6	134
	1614.0						51.25	135
	1615.06						52.4	137
	1615.95						53.3	138
	1616.09						54.0	139
	1617.34						54.6	140
	1618.44						55.7	141

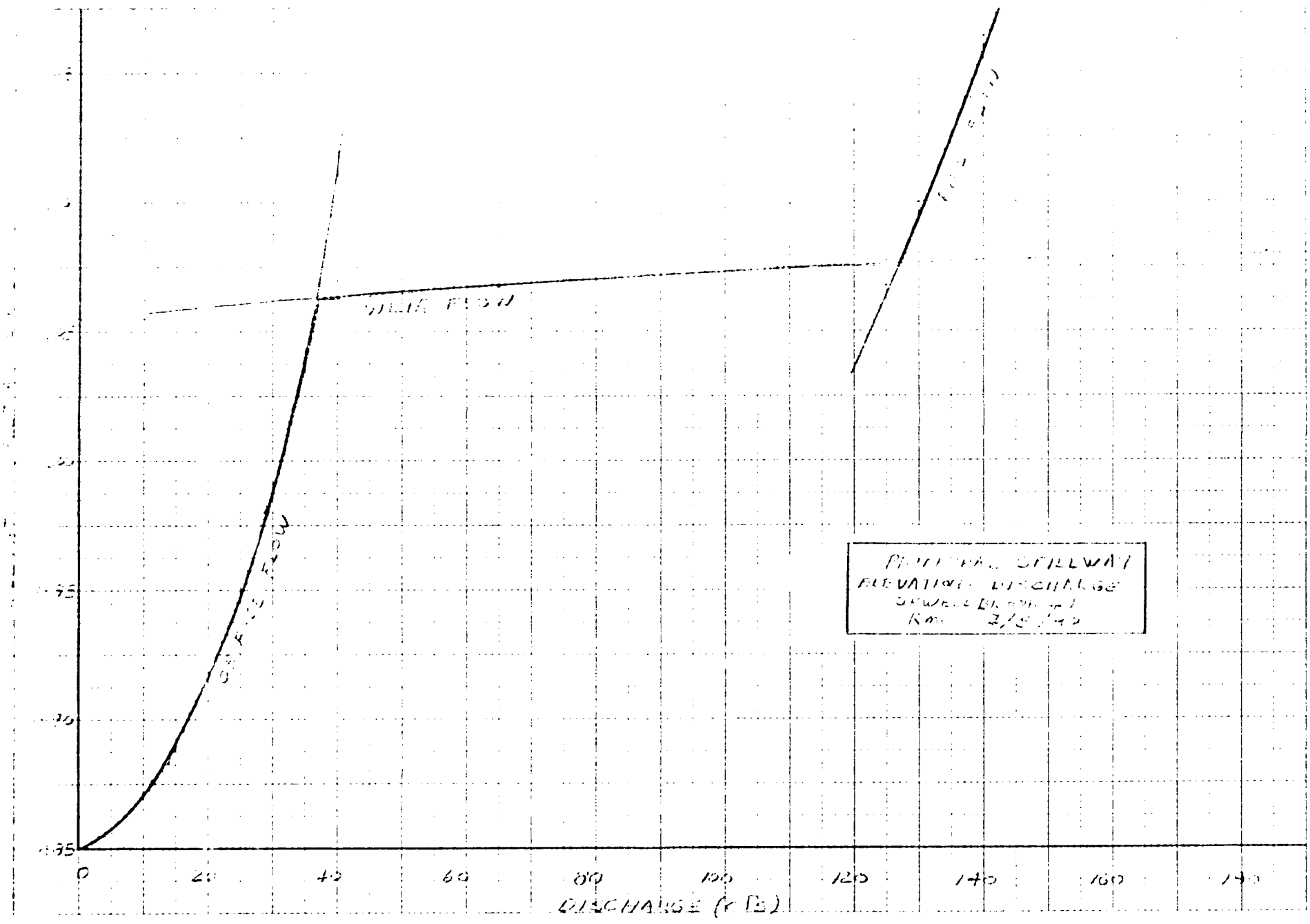
NOTE: WEIR FLOW THRU ORIFICE NEGLECTED
ORIFICE @ ELEV 1585.6
CONDUIT @ OUTLET @ EL 1562.1

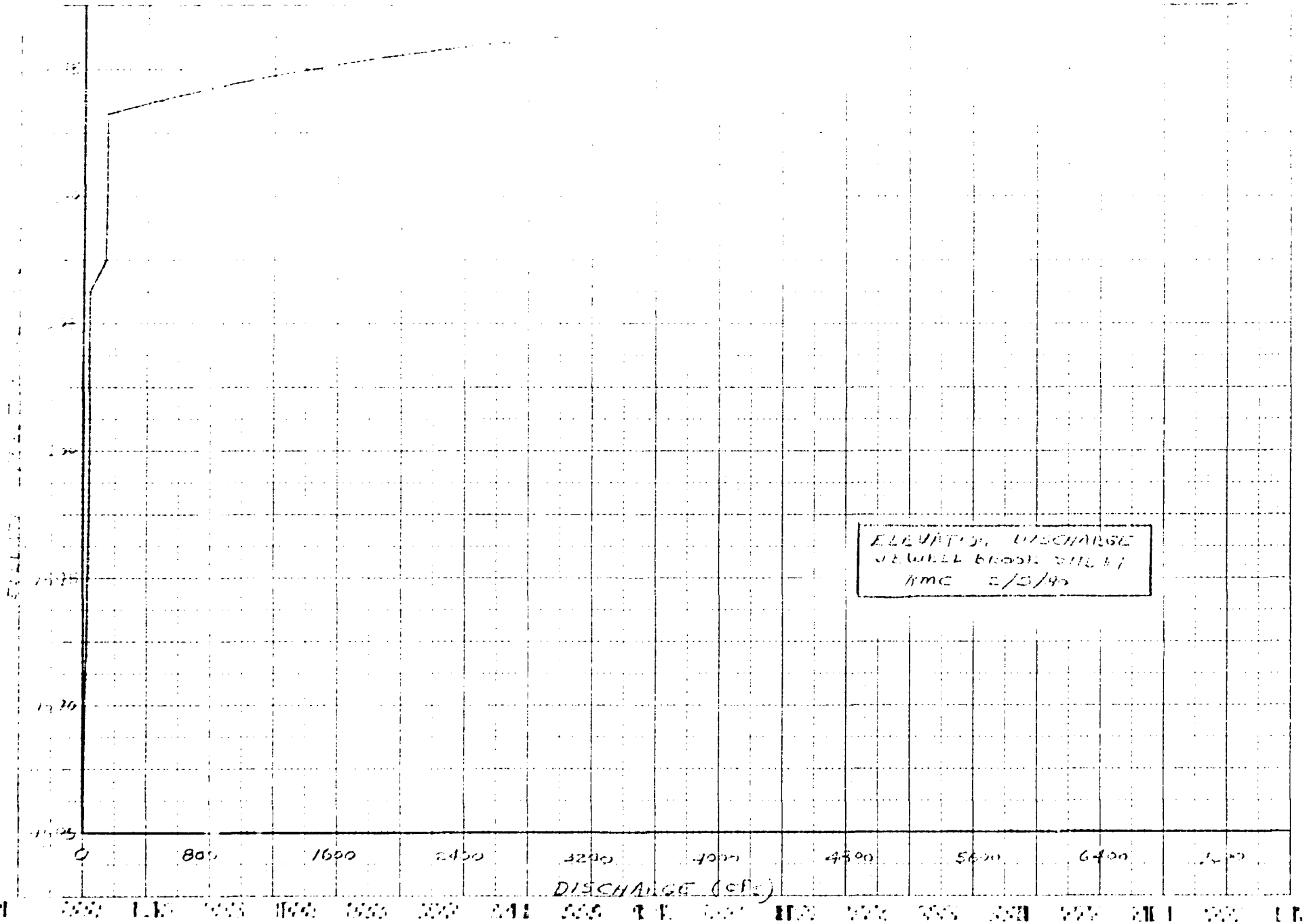
DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

UIT →	E. Spillway		TOTAL
$Q_p = 18.9 h_p^{1/2}$	H_p	Q_E	Q_T
			0
			11.4
			16.1
			24.2
			32.2
			35.9
125			102-125
127			127
130			130
134	0	0	134
135			
137	1.76	1262	1399
138	2.65	2544	2682
139	3.39	3830	3969
140	4.04	5140	5280
141	5.14	7770	7911

NEGLECTED

EL 1562.75


ORIFICE FLOW
WEIR FLOW
DISCHARGE (CFS)
0
20
40
60
80
100
120
140
160
180


ELEVATION - FEET
DISCHARGE (cfs)
0
800
1600
2400
3200
4000
4800
5600
6400
7200
ELEVATION - DISCHARGE
at WELL BROOK SITE #1
RMC 2/3/95

Job No. 9111 Sheet 12 of 21
Project Jewett Brook #1 Date 2/5/80
Subject Hydraulics / Hydrology By RMC Ch'k. by

STEP 3 EFFECT OF SURCHARGE STORAGE ON PMF

Q_{P_1} = 5300 cfs surcharge elevation$_1$ - 1617.1' (see rating curve page 11)

STOR$_1$ = SURCHARGE VOLUME (see curve, page 4)

@ elevation 1617.1' surcharge volume = 516 a-f

$$STOR_1 = \frac{516 \text{ a-f} \times 12''/ft}{1338 \text{ acres}} = 4.6278''$$

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{STOR_1}{19''}\right) = 5300\left(1 - \frac{4.6278}{19}\right) = 4007 \text{ cfs}$$

SURCHARGE ELEVATION$_2$ = 1616.75'

STOR$_1$ = 504 a-f

$$STOR_2 = \frac{504 \text{ a-f} \times 12''/ft}{1338 \text{ acres}} = 4.5202''$$

$$STOR_{ave} = (4.5202 + 4.6278)/2 = 4.5740''$$

$$Q_{P_3} = 5300\left(1 - \frac{4.5740}{19}\right) = 4024 \text{ cfs}$$

SURCHARGE ELEVATION$_3$ = 1616.75'

SURCHARGE ELEVATION$_3$ = SURCHARGE ELEVATION$_2$ = 1616.75'

NO FURTHER ITERATIONS NECESSARY, VALUES WILL NOT CHANGE SIGNIFICANTLY

CONCLUSIONS

1) Reservoir storage will reduce the Test inflow of 5300 cfs to an OUTFLOW of 4024 cfs, or by 24%

2) THE spillways can pass 100% of the routed test flood discharge w/o dam overtopping occuring

3) The dam will have a freeboard of 1.5 feet (water surface elevation of 1616.5', when the test flood is routed.

Job No. 9111 Sheet 13 of 21
Project Jewell Brook #1 Date 2/5/80
Subject Hydrology By RMC Ch'k. by

DOWNSTREAM DAMAGE ESTIMATE

STEP 1 RESERVOIR CAPACITY - WATER SURFACE ASSUMED AT CREST OF EMERGENCY SPILLWAY (el. 1613.3')

STORAGE = 420 a-f

AT TEST FLOOD ELEVATION (el 1616.8') STORAGE = 521.2 a-f

STEP 2 PEAK FAILURE OUTFLOW - "SUNNY DAY DAM BREACH"

$$Q_{P_1} = \frac{8}{27} W_L \sqrt{g} \, Y_o^{3/2}$$

W_L: up to 40% of dam width

Y_o: height from pool level to US invert

Reasonable assumption for breach width would not be 40% of dam width (450'), or 180'. Better assumption in this case is 15% of total width or 67.5' which approximates a trapezoidal X section with a TW of 67.5 side slopes of 1.0 vert. to 0.5 horiz

Y_o = 1613.3' (pool E spillway)
- 1571.0 (US invert)
Y_o = 42.3'

Ref: Handbook of Dam Safety, ASCE, 1979 page 445.

$$Q_{P_1} = \frac{8}{27} (0.15)(450)\sqrt{32.2}\,(42.3)^{3/2}$$

Q_{P_1} = 31,223 cfs say 31,250 cfs

"DAM FAILURE DURING TEST FLOOD"

$$Q_{P_2} = \frac{8}{27} (0.15)(450)\sqrt{32.2}\,(45.8)^{3/2}$$

Y_o = 1616.8 - 1571.0 =
Y_o = 45.8'

Q_{P_2} = 35,177 cfs

Base flood (Tc = natural discharge) = 4024 cfs

BREACH FLOW TO BE ROUTED IS SUM OF TWO

Q_{P_2} = 35,177 + 4024 = 39,201 cfs say 39,200 cfs

Job No. 7111 Sheet 14 of 21
Project Jewell Brook #1 Date 2/5/80
Subject Hydraulics By RMK Ch'k. by

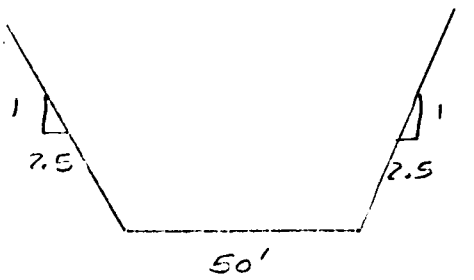
STEP 3 DEVELOP DOWNSTREAM RATING CURVES FOR CHANNEL ROUTING

REACH 1 - Jewell Brook

Site #1 thru confluence w/ Saunder's Brook

CHARACTERISTICS

XS Approximated from USGS mapping



L = 6000'

$\Delta elev$ = 1560 - 1260

$\Delta elev$ = 300'

$S = \frac{\Delta elev}{L} = \frac{300}{6000} = 0.05$ ft/ft

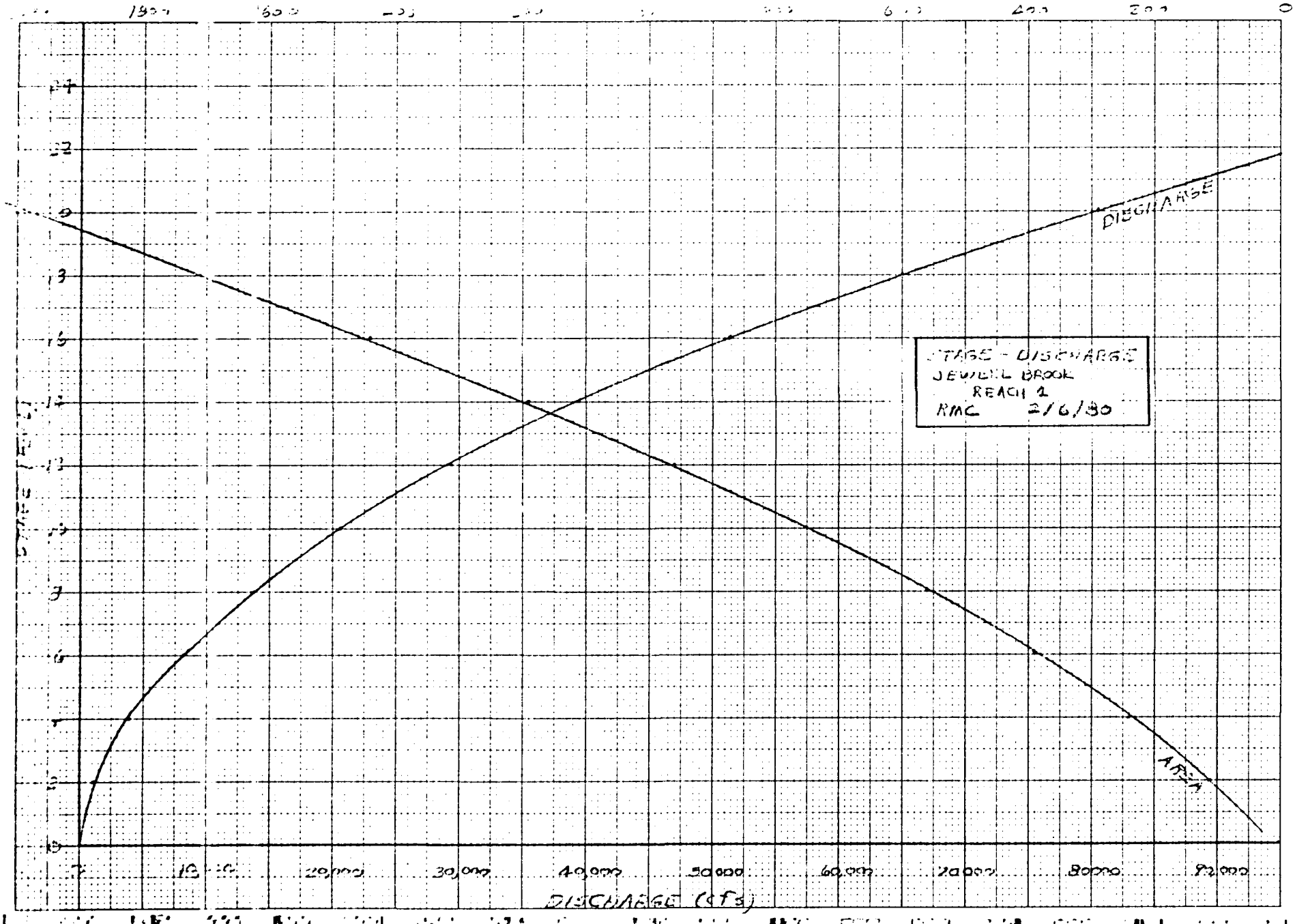
n = 0.045 rock, woods

STAGE (ft)		AREA * (ft^2)	HYDRAULIC RADIUS * (ft)		FLOW (cfs)
2		110.0	1.81		1210
4		240.0	3.35		3778
6		390.0	4.74		8148
8		560.0	6.02		13721
10		750.0	7.22		20743
12		960.0	8.38		29,324
14		1190.0	9.49		39,493
16		1440.0	10.56		51382
18		1710.0	11.64		65026

* Refer - USBR Hydraulic and Excavation Tables

Normal Flow computed via Mannings Equation

$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$



Job No. 91111 | Sheet 16 of 21
Project Jewell Brook #1 | Date 2/6/80
Subject Hydraulics | By RMC Ch'k. by

REACH 2 - Jewell Brook

confluence w/ Saunders Brook thru Village of Ludlow

CHARACTERISTICS

L = 6800'

ΔElev = 1260 - 1020

ΔElev = 240'

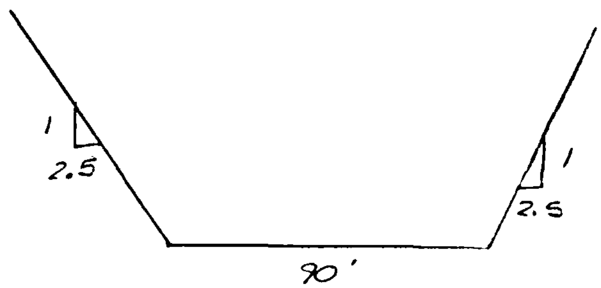
$S = \frac{\Delta Elev}{L} = \frac{240'}{6800'}$

S = 0.03529 %

n = 0.04 [illegible]

[illegible]

X S Approximated from USGS Mapping

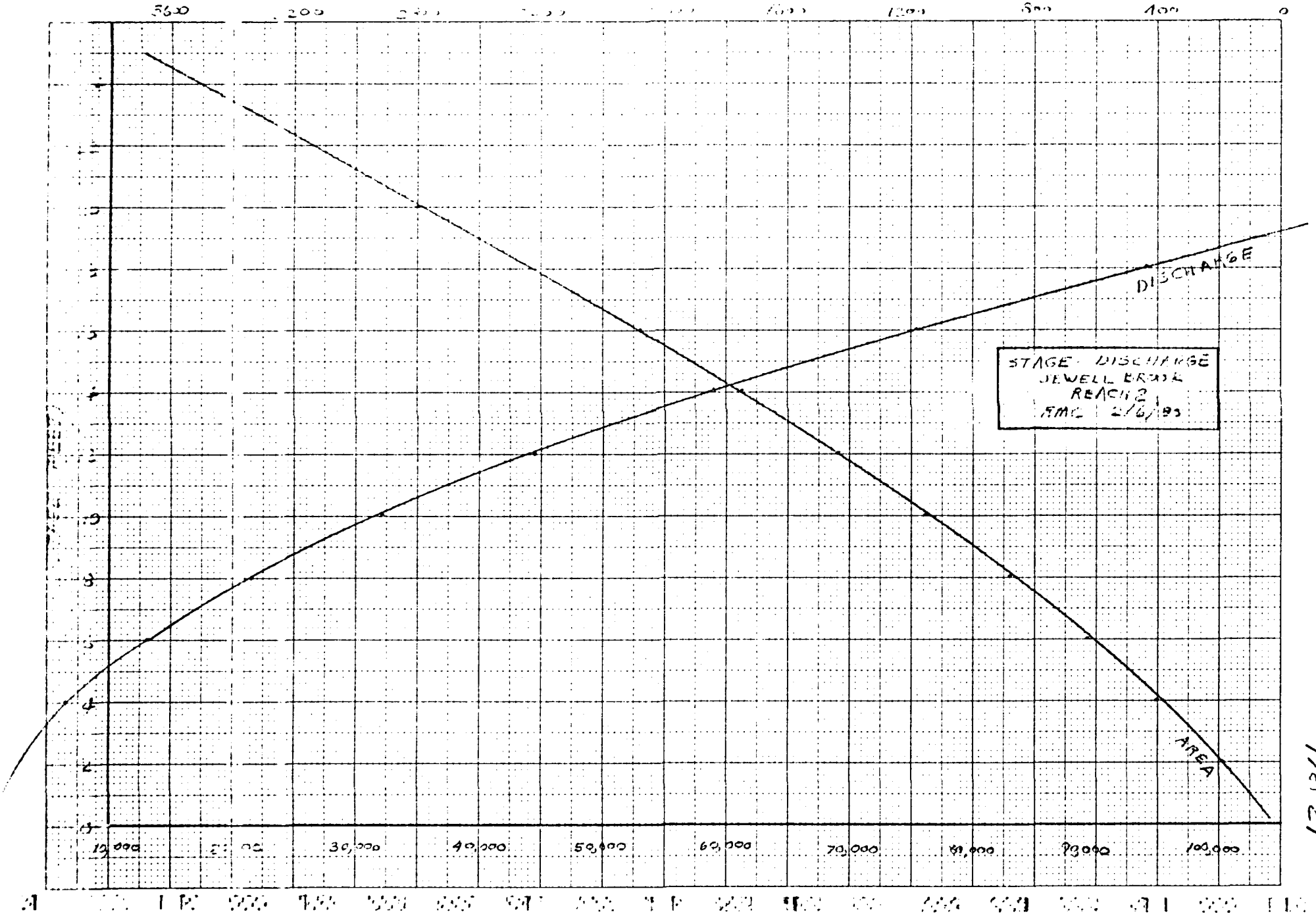


* Refer USGS [illegible] and [illegible] Tables

Note: Flow computed via Manning's Equation

$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

STAGE (ft)		AREA* (ft²)	HYDRAULIC RADIUS (ft)		FLOW (cfs)
2		170.0	1.87		2033
4		400.0	3.59		6563
6		630.0	5.15		13148
8		880.0	6.61		21690
10		1150.0	7.97		32164
12		1440.0	7.31		44,597
14		[illegible]	[illegible]		[illegible]
16		2080.0	11.81		75487
18		2430.0	13.00		94018
20		[illegible]	14. [illegible]		[illegible]



Job No. 91111 Sheet 18 of 21
Project Jewell Brook #1 Date 2/6/80
Subject Channel Routing By RMC Ch'k. by

STEP 4 ROUTE DAM BREACH FLOW "SUNNY DAY FAILURE"

Q_{P_1} = 31,250 cfs stage = 12.5' area = 1025 □'

ENTER REACH 1

L_1 = 6000'

$V_1 = \frac{6000' \times 1025\ \square'}{43560\ \square'/acre} = 141.2$ a-f $< \frac{420}{2}$ a-f ∴ L is OK

$Q_{P_{trial}} = Q_{P_1}\left(1 - \frac{V_1}{S}\right) = 31250\left(1 - \frac{141.2}{420}\right) =$

$Q_{P_{trial}}$ = 20745 cfs

stage = 10.0' area = 750 □'

$V_2 = \frac{750\ \square' \times 6000'}{43560} = 103.3$ a-f

$V_{ave} = (141.2 + 103.3)/2 = 122.3$

$Q_{P_2} = 31250\left(1 - \frac{122.3}{420}\right) = 22{,}154$ cfs ≈ 22,200 cfs

OUT FLOW = 22,200 cfs stage = 10.4'

ENTER REACH 2

stage = 8.2' area = 880 □'

$V_1 = \frac{880\ \square' \times 6800'}{43560\ \square'/acre} = 137.4$ a-f $< \frac{420}{2}$ a-f ∴ L is OK

L_2 = 6800'

$Q_{P_{trial}} = 22{,}200\left(1 - \frac{137.4}{420}\right) = 14{,}539$ cfs

stage = 6.4' area = 660 □'

$V_2 = \frac{(660\ \square') \times 6800'}{43560} = 103.0$ a-f

Job No. 9111 Sheet 19 of 21
Project Jewell Brook #1 Date 2/6/80
Subject Channel Routing By RMC Ch'k. by

$V_{ave} = (137.4 + 103.0)/2 = 120.2$ a-f

Q_{P_2} 22,200 $\left(1 - \frac{120.2}{420}\right)$ = 15846 cfs ≈ 15,900 cfs

OUTFLOW = 15,900 cfs stage = 6.7'

"DAM BREACH DURING TEST FLOOD"

ENTER REACH 1

Q_{P_1} = 39,200 cfs stage = 14.0' area = 1200 □'

$V_1 = \frac{6000' \times 1200 \square'}{43560 \square'/\text{acre}} = 165.3$ a-f < $\frac{521.2}{2}$ a-f

L is OK

$L_1 = 6000'$ $Q_{P_{ave}} = 39,200 \left(1 - \frac{165.3}{521.2}\right) = 26,768$ cfs

stage = 11.5' area = 910 □'

$V_2 = \frac{910 \times 6000}{43560} = 125.3$ a-f

$V_{ave} = (125.3 + 165.3)/2 = 145.3$ a-f

$Q_{P_2} = 39,200 \left(1 - \frac{145.3}{521.2}\right) = 28,270$ cfs

OUTFLOW = 28,270 STAGE = 11.8'

ENTER REACH 2

stage = 9.4' area = 1050 □'

$V_1 = \frac{6800' \times 1050 \square'}{43560 \square'/\text{acre}} = 163.9$ a-f < $\frac{521.2}{2}$ a-f

$L = 6800'$

L is OK

Job No. 91111 Sheet 20 of 21
Project Jewell Brook #1 Date 2/21/80
Subject Channel Routing By FMC Ch'k. by

$$Q_{p_{trial}} = 28270\left(1 - \frac{163.9}{521.2}\right) = 19{,}379 \text{ cfs}$$

stage = 7.6' area = 800 □'

$$V_2 = \frac{6500' \times 800\,\square'}{43560} = 124.9 \text{ a-f}$$

$$V_{ave} = (124.9 + 163.9)/2 = 144.4 \text{ a-f}$$

$$Q_{p_2} = 28{,}270\left(1 - \frac{144.4}{521.2}\right) = 20{,}438 \text{ cfs} \approx 20{,}500 \text{ cfs}$$

OUTFLOW = 20,500 cfs STAGE = 7.8'

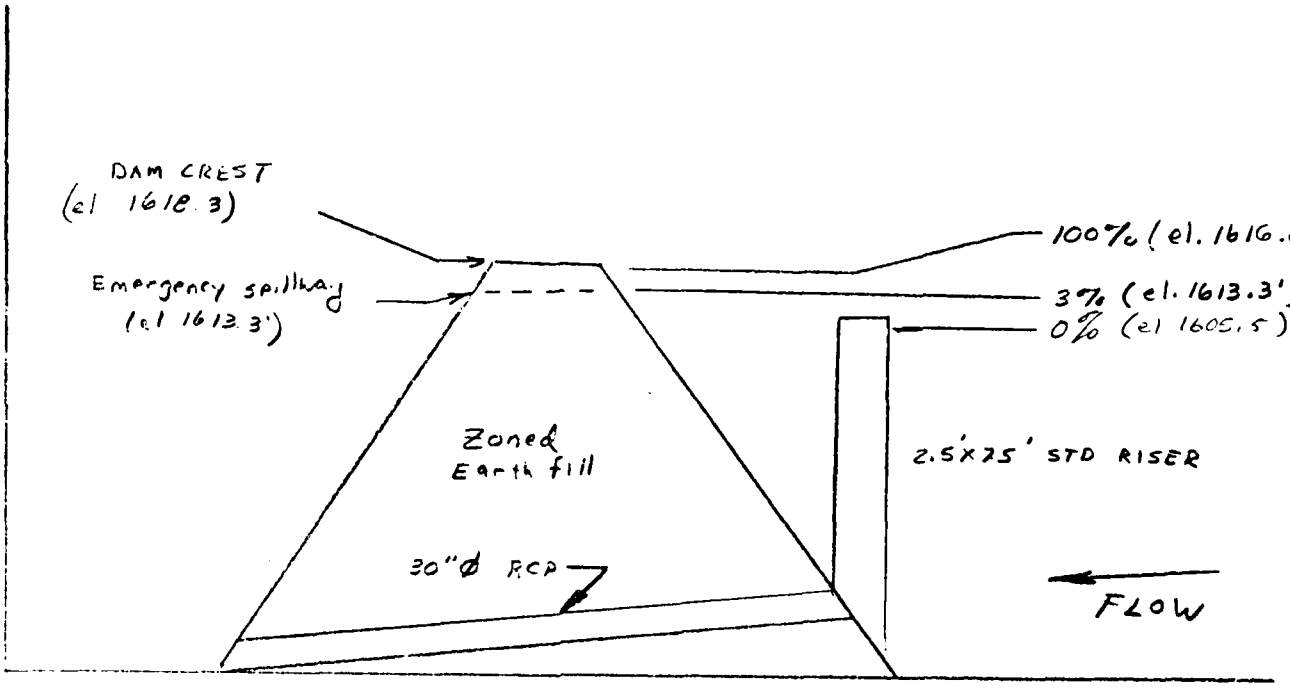
SUMMARY

Test flood stage

REACH	"SUNNY DAY DAM BREACH" AND DISCHARGE THRU E. Spillway) DISCHARGE	STAGE	"DAM BREACH DURING TEST FLOOD" DISCHARGE	STAGE
AT DAM	31250 cfs	12.5'	39,200 cfs Test flood stage = 4.5' Wave height = 9.5'	14.0'
6000' DS (CONFLUENCE OF JEWELL BROOK AND SANDERS BROOK)	22,200 cfs	10.4'	28,270 cfs Test flood stage = 4.5' Wave height = 7.3'	11.8'
12,800' DS (CENTER VILLAGE OF LUDLOW)	15,900 cfs	6.7'	20,500 cfs Test flood stage = 3.5' Wave height = 4.3'	7.8'

[illegible] approximately six feet above streambed

Job No. 91111 Sheet 21 of 21
Project Jewell Brook Site 1 Date 2/6/80
Subject Reservoir Data By RMC Ch'k. by

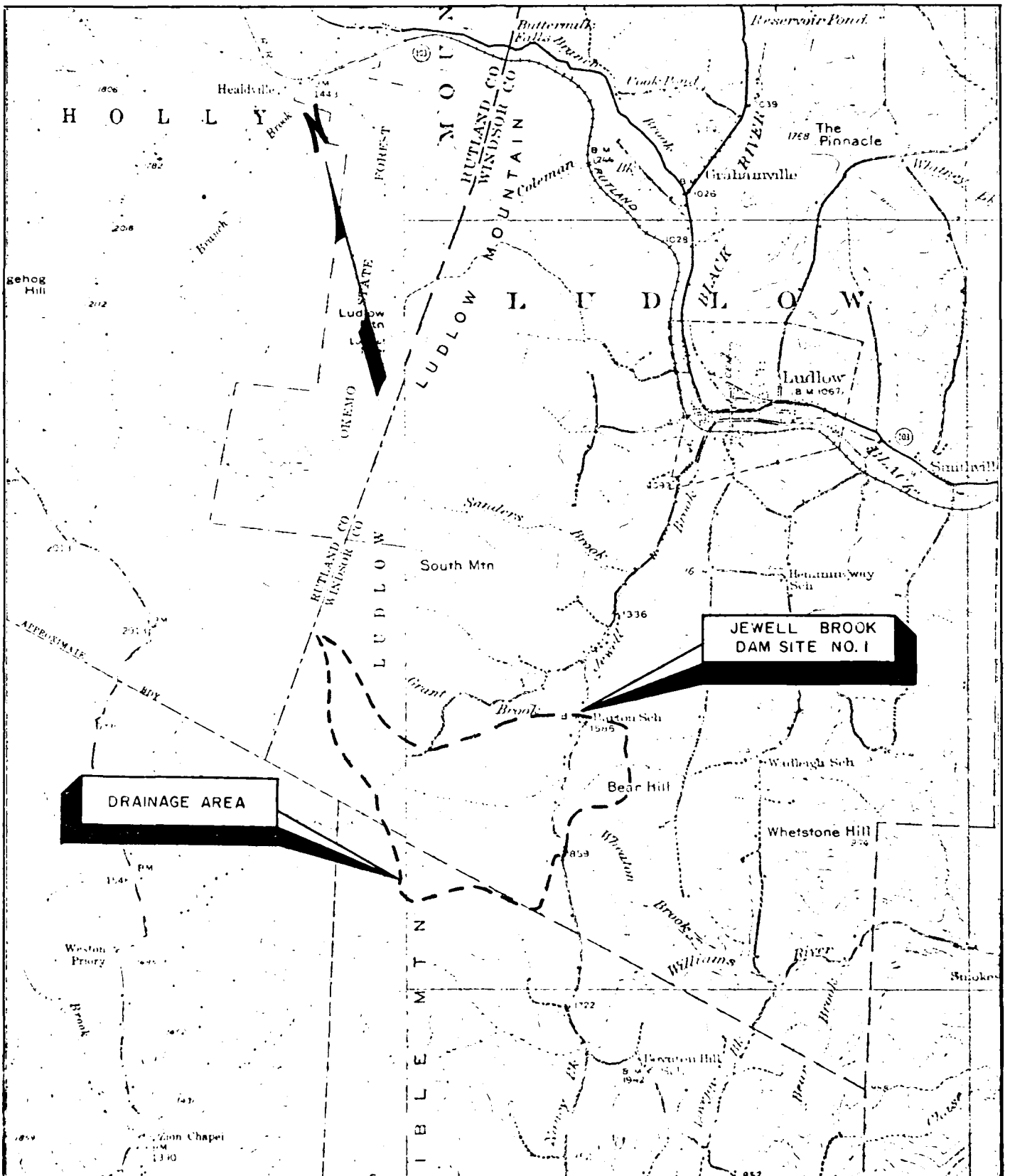


NOT TO SCALE

TEST INFLOW= 5300 cfs

RESERVOIR DATA
Jewell Brook Site #1

% OF TEST FLOOD discharge	DISCHARGE (cfs)	DAM CONDITIONS	WATER SURFACE ELEVATION
100%	4024	1.45' Freeboard	1616.8'
3%	134	UP TO EMERGENCY SPILLWAY	1613.3'



DuBois & King INC.

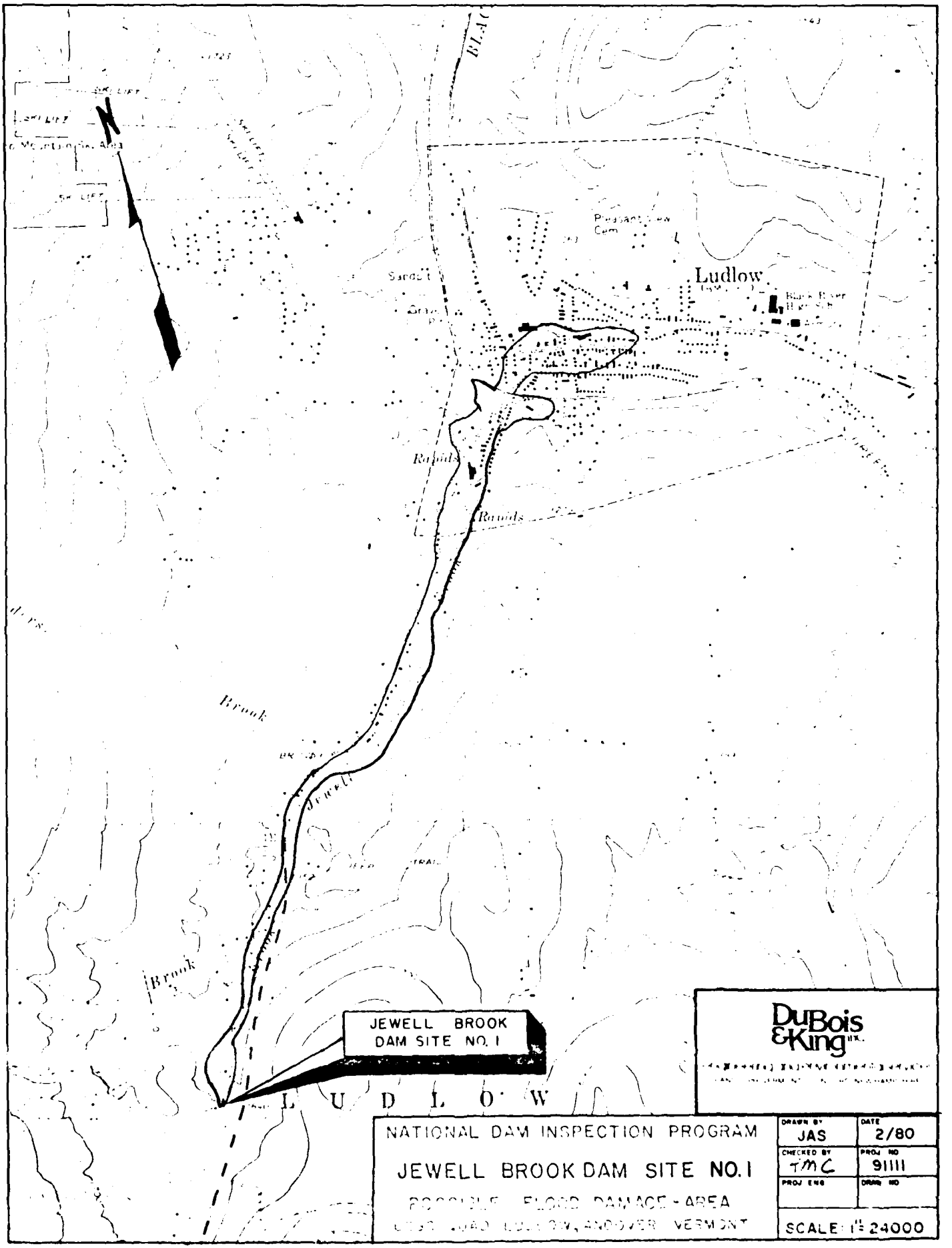
NATIONAL DAM INSPECTION PROGRAM

JEWELL BROOK DAM SITE NO. 1

DRAINAGE AREA

DRAWN BY	DATE
JAS	2/80
CHECKED BY	PROJ NO
MC	91111
PROJ ENG	DRWG NO

SCALE 1" = 2500'



DuBois & King INC.

NATIONAL DAM INSPECTION PROGRAM

JEWELL BROOK DAM SITE NO. 1

POSSIBLE FLOOD DAMAGE AREA

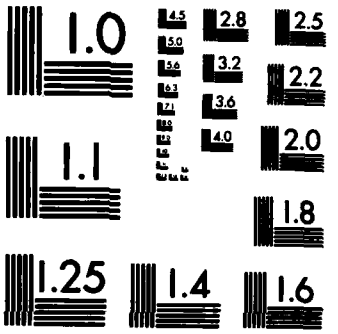
USGS QUAD LUDLOW, ANDOVER VERMONT

DRAWN BY	DATE
JAS	2/80
CHECKED BY	PROJ NO
TMC	91111
PROJ ENG	DRWG NO

SCALE 1" = 24000'

AD-A157 218 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS JEWELL BROOK DAM SITE.. (U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV APR 80 2/2

UNCLASSIFIED F/G 13/13 NL



APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY | MO | YR
VT	14	NED	VT	027	01				JEWELL BROOK SITE NO. 1	4521.7	7243.4	18JUL80

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
	JEWELL BROOK SITE NO. 1 RESERVOIR

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	08	JEWELL BROOK	VILLAGE OF LUDLOW	2	1481

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	(27) NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
EDG	1960	C	69	66	531	17	NED	N	N	N	B	

(28) REMARKS

(29) D/S HAS	(30) SPILLWAY CREST LENGTH	(31) TYPE	(32) WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) PROPOSED (MW)	(37) NO.	(38) NAVIGATION LOCKS LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
Y	850	U	250	7240	144928											

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
TOWN OF LUDLOW, VT.	USDA SOIL CONS. SERVICE	WELCH AND CORR

(49) REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
VT DEPT NTR RES	VT DEPT NTR RES	VT DEPT NTR RES	VT DEPT NTR RES

(50) INSPECTION BY	(51) INSPECTION DATE DAY | MO | YR	(52) AUTHORITY FOR INSPECTION
DUBOIS & KING INC.	31OCT79	P.L. 92-367

(53) REMARKS

END

FILMED

9-85

DTIC